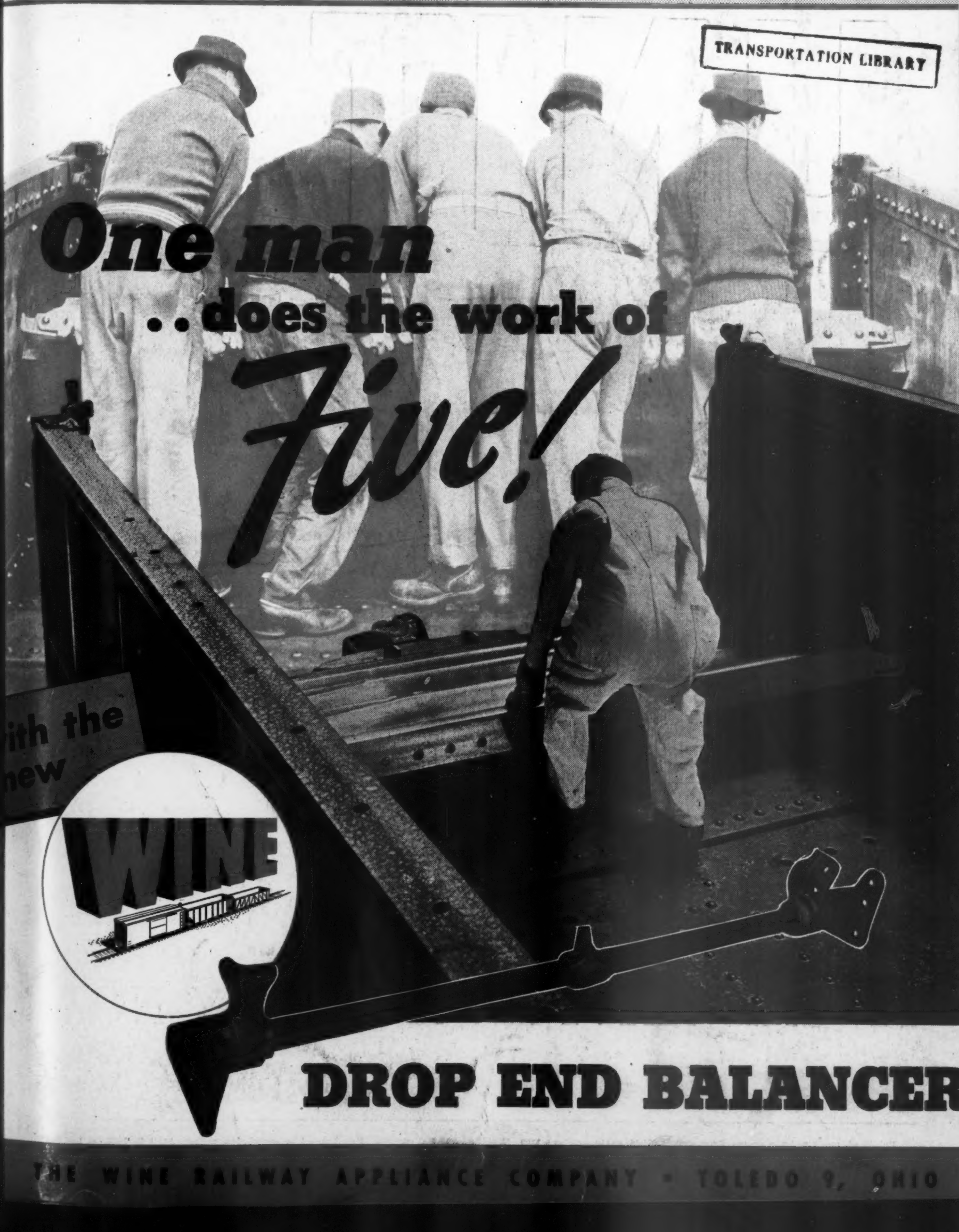
Railway Mechanical Engineer

December 1947



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RAILWAY
MECHANICAL ENGINEER

Pullman-Standard Develops

General-Service Box Car

Unusual number of components produced by builder to control deliveries and keep down cost—14,000 on order for 13 roads

THE Pullman-Standard Car Manufacturing Company has recently developed a 50-ton, 40-ft. 6-in. general-purpose box-car design, known as the P-S-1 which is built primarily of welded, copper-bearing, open-hearth steel and has a nominal light weight of 45,500 lb. About 14,000 of these cars have been ordered to date by 13 railroads and 1,500 completed at the company's Michigan City, Ind., plant.

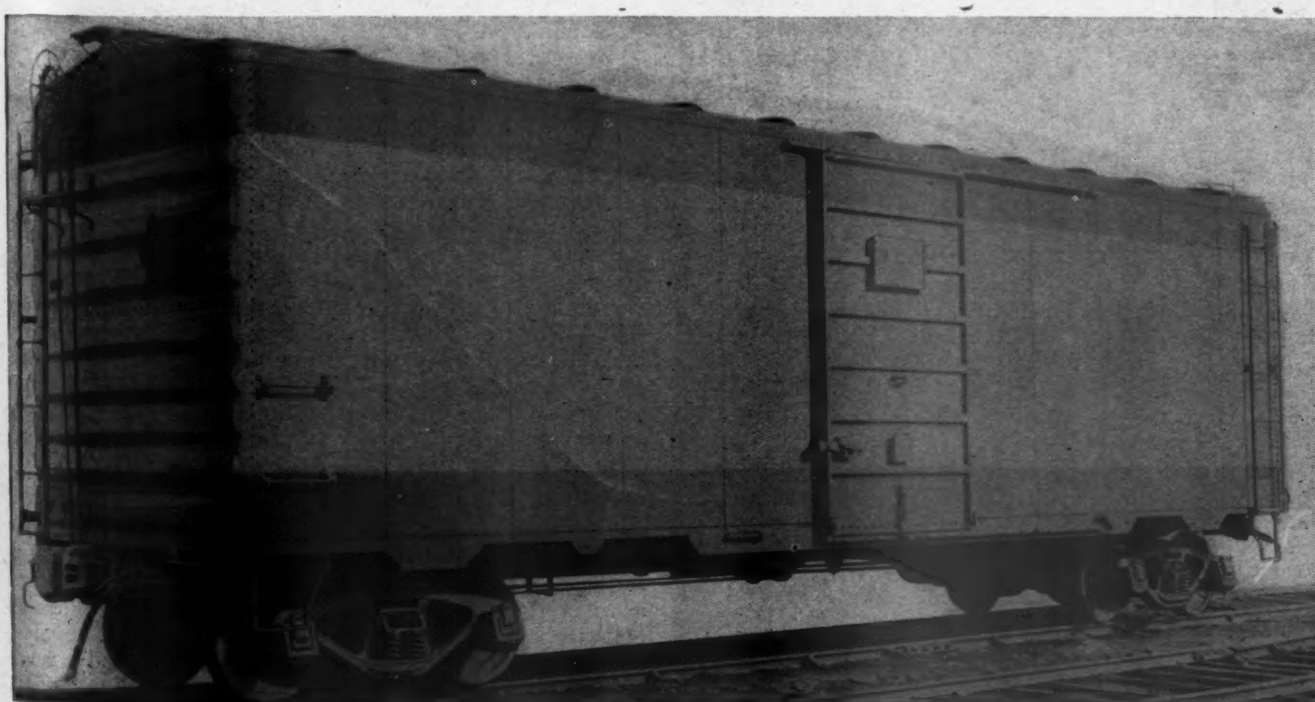
The P-S-1 box car design incorporates to an unusual degree component parts, engineered and manufactured by the car builder with the objective of controlling production and assuring rapid delivery of cars at reduced unit cost. The unit-design cars are also expected to prove exceptionally sturdy and durable in service with attendant savings in maintenance cost and reduced out-of-service time for repairs.

Pullman Features and Innovations

Major Pullman-developed features and innovations in the P-S-1 car include the underframe with welded draft sill, built-up welded bolsters and continuous floor stringers, all arc welded; automatic arc-welded sides with sheets placed on the outside of Z-bar side posts, side plates and side sills and continuously welded in place; two-part riveted ends, with 4-in. deep corrugations spaced 12 in. on centers; either arc-welded or riveted roof with carlines standing up on the outside of the car; arc and spot-welded side doors with overlapping corrugations for strength and rigidity; and numerous other smaller items, as shown in the latter part of this article.

Parts of the P-S-1 car, purchased as specialties from other manufacturers and suppliers include: air brakes, hand brakes, running boards, draft gears, couplers, truck frames, bolsters, brake beams and other parts, as described in the last two paragraphs.

All materials used in the car, as well as design features, conform to A. A. R. specifications and strength requirements. All mild open-hearth steel shapes, plates, bars and sheets, ¼ in. and less in thickness are copper bearing. The side sill and end-sill angles also are made of copper-



Pullman-Standard's P-S-1 box car

bearing steel. Lumber for the framing, decking and lining is southern yellow pine, Douglas fir, or western hemlock.

The center sills are A. A. R. Z-26 36.2-lb. sections with the top flanges hand arc welded together the full length of the car. The draft sill construction is the latest Pullman built-up design including draft lugs, bolster center fillers, strikers and coupler carriers. The coupler carrier wear plate is drop forged, A. A. R. standard.

Built-Up Body Bolsters and Other Parts

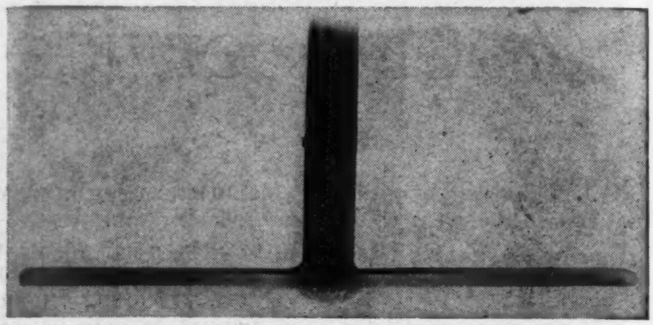
Body bolsters are built up and arc welded, forming an integral construction with the center sill. The top and bottom cover plates are 21 in. by 7/16 in. and webs are 1/4 in. thick. The top cover plate extends continuously from side to side of the car. The bottom cover plate extends from the side sill to the toe of the bottom flange of the center sill. A separate bottom plate extends under the center sill and ties the two bottom cover plates together. Side-bearing braces are formed 5/16-in. inverted U-shape pressings welded between the bolster webs. The bolsters are connected with rivets to a side-sill connection member which is a 6-in. 15.3-lb. ship channel.

Two crossbearers per car are located near the door posts, built up and arc welded with 1/4-in. webs and 8-in. by 5/16-in. top and bottom cover plates. The top of the crossbearer is contoured so that the floor stringers are supported on the top cover plate which permits the stringers to run continuously between the body bolsters.

Arc-welding operations on one of the underframes

Four crossties per car, located between crossbearers and bolsters, are made of 3/16-in. pressed plate flanged all around and riveted to the center and side sills. Four center-sill separators are 3/16-in. pressings, located at the crossties and two are 1/4-in. weldments, at the crossbearers.

The floor stringers are 3-in. 6.7-lb. Z-bars, two on each side of the center sill. The stringers are continuous in one length between body bolsters, passing over the top of the crossties and crossbearers. The stringers continue from the bolster to the end sill, two on each side of the center sill. Stringers are connected by welding to the underframe cross members and by riveting to the end sill angles.



Section of carline welded to 14 gauge roof sheet

Body center plates are drop forged A. A. R. design, secured with 7/8-in. rivets. Body side bearings are rolled or drop forged, tapered section to fit the slope of the bolster and made of 0.40 to 0.55 per cent carbon steel. The side bearing clearance is adjusted within the limits of 1/8 in. to 1/4 in., or a total of 1/4 in. to 1/2 in. at each end of the car.

Draft keys are 0.40 to 0.55 per cent carbon steel, of 6-in. by 1½-in. round edge section, quenched and tempered.

General Dimensions of P-S-1 50-Ton Box Car

Length inside, ft.-in.	40– 6
Length over strikers, ft.-in.	41–10
Length between truck centers, ft.-in.	30–10
Width inside, ft.-in.	9– 2
Height inside, ft.-in.	10– 6
Height, rail to floor, ft.-in.	3– 7¾
Side door opening, width, ft.-in.	6– 0
Estimated light weight, lb.*	45,500

* With chilled tread wheels, pine floor, pine framing and fir lining.

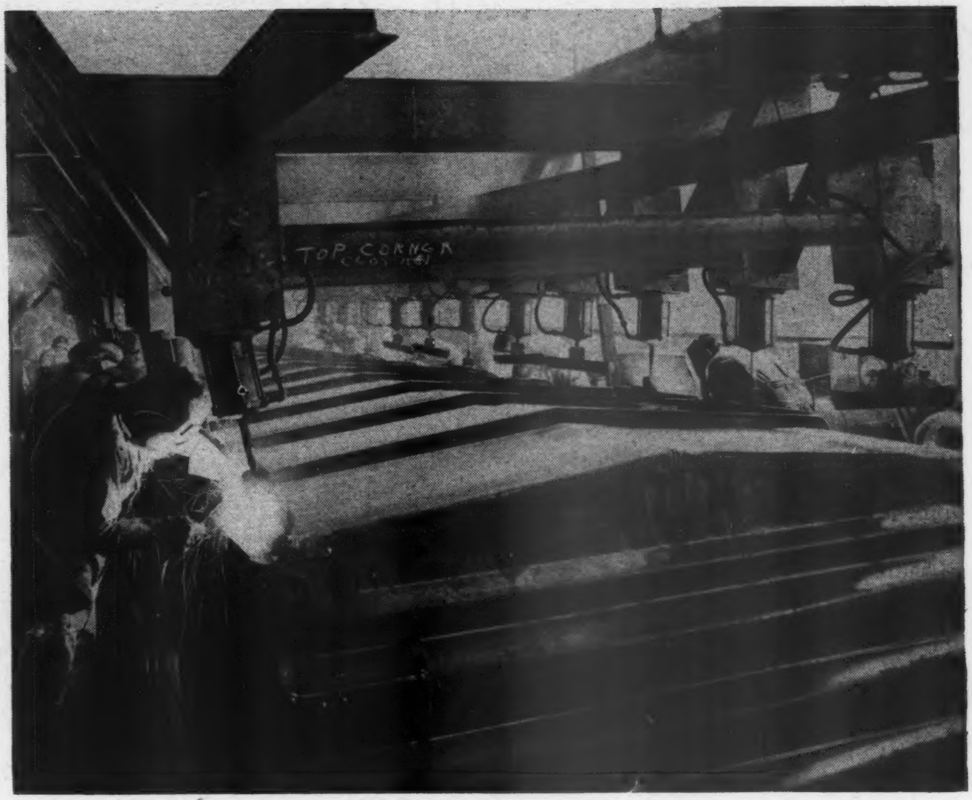
Draft-key retainers are A. A. R. T-head, secured with commercial spring cotters.

Brake equipment is the standard AB-1012 freight-car schedule, including the latest release control retaining valve and air-brake hose with FP-5 couplings. Braking power is 18.7 per cent of the gross rail load based on 50-lb. cylinder pressure. All brake pipe is extra-heavy black steel except the train-line end nipples which are 10 in. long, of standard-weight black steel pipe. All pipe fittings are extra heavy and couplings are wrought iron or steel.

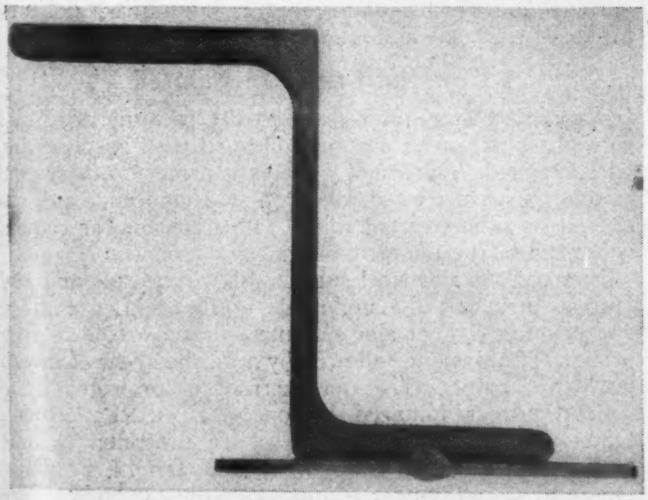
General Car Body Construction

Car sides are the Pullman automatic arc-welded type in which the side sheets are butt welded together at and to the outer flange of the Z-bar side posts. The sheets are placed on the outside of the side plate and side sill and are continuously arc welded in place. The side sheets, 0.10 in. thick, are riveted to the door and corner posts. Side plates are A. A. A. 9.9-lb. W-section S-281.

Side sills are 6-in. by 3½-in. by 5/16-in. rolled angles extending from end to end of the car. The side sill



After the assembled roof has been put in place, the car is moved under the roof hold-down jig and the roof sheets welded to the side plates



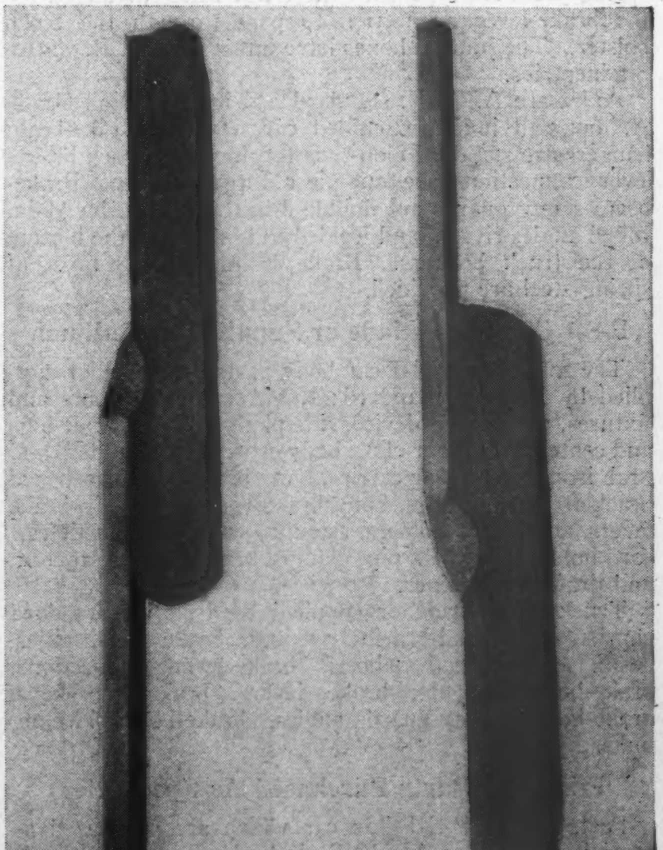
A section through side sheets welded to an intermediate side post

under the doorway is reinforced with a 5/16-in. pressed angle, arc welded to its bottom.

Intermediate side posts are 3-in. 5.1-lb. rolled Z-bars, section Z-27, sixteen per car. Corner posts are 3/16-in. pressings of Pullman design with the diagonal corner member arc welded to the inside of the steel end. Door posts are 4-in. by 3-in. by ¼-in. angle sections pressed into channel shape.

Door-post gussets of ¼-in. plate connect the door posts to the side plate and side sill. Side-door threshold plates, 3/16 in. thick, rest on the wood floor, are bolted to the side sill and flanged at the front edge.

The car ends are made in two sections riveted at the center seam, to the end sill, and to the roof. All corrugations except the top one are 4 in. deep, spaced on 12-in. centers. The bottom sections is ¼ in. thick and has five corrugations. The top section is 3/16 in. thick and has four 4-in. corrugations and one 2-in. corrugation. End sills are 6-in. by 3½-in. by 5/16-in. rolled angles extending from side to side of the car and applied with the 6-in. leg horizontal. The horizontal members of the side- and end-sill angles are adequately joined together with ¼-in. gussets. Top corner caps of ¼-in. plate, formed to rein-



Sections through vertical flanges of the side plate (left) and side sill (right) showing side-sheet welds

force the top corner of the car, are riveted and welded to exclude weather. The car has no push-pole pockets.

Optional Welded or Riveted Roof Design

Car roof sheets are steel sheets of No. 14 gauge joined together on the car-lines and secured in place by arc welding in the welded roof design. The sheets are applied on top of the flange of the W-section side plate and connected by arc welding. At each end of the car they are flanged down and are riveted to the face of the steel end.

Carlines are 2¾-in. by ¼-in. bulb-sections extending across the car. Each carline extends down and is welded to the upper vertical leg of the side plate. Carlines are spaced to accommodate standard lengths of running boards. Running-board saddles are ⅛-in. steel, flanged and arc welded to the top of the bulb section of the carline.

In the case of the alternate riveted-roof design, the No. 14 gauge galvanized roof sheets are flanged and joined together by riveting within a hair-pin type of seam cap. The sheets are flanged down and riveted to the upstanding vertical leg of the side plate Z-bar and to the face of the steel end.

The seam caps, pressed from ⅛-in. steel, extend across the car on the outside on top of the roof and are also flanged down and riveted to the vertical leg of the side plate. Seam caps are spaced on 41-in. centers so as to accommodate commercial standard lengths of running boards. The running-board saddles are pressed from ⅛-in. commercial galvanized sheets.

Features of the Truck Design

The 50-ton trucks have a wheel base of 5 ft. 6 in. and side-bearing center spacing of 4 ft. 2 in. They are of the spring-plankless type with the truck brake arranged for the brake-lever connection to pass through the truck bolster. The journal boxes have integral A. A. R. waste-retainer ribs.

Axles are A. A. R. standard 5½-in. by 10-in., Grade A, mounted in 33-in. chilled car wheels. Brake-beam hangers are standard loop-type forgings and truck brake-lever connections are one-piece forged design. Brake-beam safety guards are double 3-in. by 2½-in. by ¼-in. rolled angles riveted and welded to brackets at the bottom of the truck bolsters. Brake beam leveling links of spring steel are provided.

P-S-1 Car Parts Made or Supplied by Pullman

The following P-S-1 car body parts are made or supplied by Pullman-Standard: Roof, ends, side doors and fixtures, uncoupling device, side plate, strikers, draft lugs and center filler, floor clips, body center plate, ladders and grab irons, draft-gear carrier, body brake pins, cardboard brackets and bindings, body brake-rod jaws, body brake levers, angle cock holders, retaining-valve anchor, defect-card holder, A. A. R., pipe clamps, branch-pipe T-anchor, and draft-key retainer.

Truck parts made or supplied by Pullman-Standard consist of journal-bearing wedges, brake pins, axles, 33-in. chilled-tread wheels, brake-lever connections, brake-beam hangers, brake levers, brake-shoe keys, brake-beam safety-guard angles, brake-beam leveling links.

P-S-1 Car Parts Purchased As Specialties

Parts of the P-S-1 box car which are purchased as specialties include: AB 1012 air brakes, running boards and brake steps, vertical-wheel hand brakes, draft gears, couplers and coupler yokes.

Truck specialties include: Brake beams, brake-beam-hanger wear plates, leather fiber dust guards, dust-guard plugs, journal bearings, journal-box lids, side bearings, springs and spring plates, truck sideframes, bolsters, brake shoes, waste and oil.

Pullman floor clip installation (inverted)

How the Cars Are Painted

Particular attention is paid to the painting of P-S-1 box cars. All metal parts are cleaned with gasoline and wire brushed. Laps and joints are protected by a coat of joint paste at riveted joints on sides and ends and car cement on other riveted joints. One coat of car cement is applied to the underframe.

Exposed interior steel surfaces above the side and end linings, including the underside of the roof, are given one priming coat of zinc chromate or red oxide of iron primer or equivalent, followed by a finished coat of metallic brown paint. The outside roof is protected by a similar primer followed by one coat of car cement. Outer surfaces of the car sides are protected by one primer coat and two coats of metallic freight-car paint. One coat of car cement is applied to the car ends. Side doors are protected by one primer coat and two coats of metallic-freight-car paint. Before installing any woodwork, the sides and ends inside are given one coat of car cement. Truck frames and bolsters receive one coat of standard red mineral primer at the foundry followed by one coat of ready mixed black paint after assembly. All primers and paints for the finish coats are of the fast drying, two-coats-a-day type.

Equipment on Order.—Railroads and private car lines had 126,213 new freight cars on order on November 1, as compared with 116,546 on October 1, according to the Association of American Railroads. Of the former total, Class I roads and railroad-owned private-controlled refrigerator companies had 109,467 new freight cars on order, including 43,934 hopper cars, of which 3,443 were covered hoppers; 10,789 gondolas, 884 flat, 6,538 refrigerator, 750 stock, 333 miscellaneous freight cars and 46,239 box cars, including 43,397 plain and ventilated and 2,842 automobile box cars. The Class I roads also had 967 lcomotives on order on November 1, compared with 573 on the same day in 1946. This year's total included 45 steam, four electric and 918 Diesel-electric locomotives.

"A valuable piece of equipment that is in itself a fire hazard"

Eliminating

Diesel Fire Losses*

By R. J. Snowdon†

Preventive and protective measures for Diesel locomotives presented at meetings of the National Fire Protection Association and F. P. & I. section of A.A.R.

In 1945, the average loss per fire for Diesel locomotives was $2,133 compared with $339 for steam locomotives.

It should not be difficult to understand that an internal-combustion engine, powered by and running in oil, will be oil soaked, and if not properly cleaned, will gradually coat itself with dust deposits which rapidly build up into a greasy coat of dirt. It is this oily film that creates the hazard in the Diesel locomotive. Unlike the steam locomotive, the Diesel is an exposure to itself.

Diesel fuel oil will seep through some of the tightest joints, keep the floors inside the engine room oil soaked, and spread oil over the underframe and the trucks where it is exposed to sparks from brake shoes at each stopping of the train. The theory has been advanced that fuel oil will ignite only when subjected to the conditions prevailing inside the Diesel engine cylinders on the compression stroke, but actual fire losses indicate that oil deposits are readily ignited by molten particles of brake shoes.

Our main consideration being the reduction of fire losses, we should aim at their elimination. About the best way to eliminate fire losses is to prevent fires. The keystone of fire prevention is good housekeeping, and it is in this field that good housekeeping will really pay for itself.

Make Cleaning Easier

But good housekeeping is impracticable when construction methods defeat this important detail. Exposed pockets in the underframe and superstructure in which oil soaked diret accumulates and which form ready receptacles for waste paper and other rubbish make housekeeping difficult and expensive. The removal of doors from enclosures under cabs open up a hiding place for wind blown paper cups, wiping rags and incandescent-light wrappers. The location of fuel and lubricating-oil pipe lines and electric-circuit conduits in corners and on the floor make thorough cleaning impossible. The failure to provide racks for spare knuckles, re-railers, chain, spare steam connectors, air and signal hose, fuses, torpedoes, and lanterns in the nose of the locomotive causes employees to dump this equipment on the floor, among which combustible rubbish accumulates to create a fire hazard.

To make thorough cleaning possible, the manufacturers of Diesel locomotives should consider closing the superstructure and underframe pockets with light metal sheets so that dirt and oil can be easily and quickly removed. If enclosing the space under cabs impairs the operation of traction-motor blowers, then screen doors should be used to keep rubbish out. A more suitable location should be found for piping so that it can be readily and properly cleaned, and some sort of practical arrangement should be devised for the storage of spare parts kept in the nose so that the floor will be clear and cleanable. Below the underframe a suitable guard should be provided around the fuel tank to protect it from being punctured by flying objects.

These are a few of the improvements that could be made in the design of the locomotive by the builders, so that their product would be easier to clean and more rapidly prepared for further service.

Much publicity has been given to the high mileage these locomotives can run in continuous service as com-

* Abstract of address made at the meeting of the Railroad Section, National Fire Protection Association at Chicago on May 26 and at the meeting of the Fire Protection and Insurance Section, Association of American Railroads, at Chicago on October 23 and 24. This address was included in the June, 1947, issue of the News Letter published by the F. P. & I. Section, A. A. R.

† Supervisor of fire prevention, Seaboard Air Line.

pared with the interrupted service performed by steam locomotives, which are shopped for long periods after running their assigned mileage. High mileage is made possible principally by the short layover periods at terminals and the long runs made. The short layover periods tend to curtail the running maintenance and cleaning given these locomotives, and the long runs increase the wear and need for more thorough cleaning.

Maintenance Hazards

In the maintenance of Diesel locomotives every precaution should be taken to prevent fire. Smoking should be prohibited in or around the locomotive. Portable electric lights should be equipped with vapor-proof globes and if welding or cutting is necessary, a carbon-dioxide, carbon-tetrachloride, or dry-powder fire extinguisher should be kept handy, ready for use. Water, in fog form, is satisfactory, if available.

The use of flammable liquids as solvents should be prohibited. Recently, a fire, happily a small one, resulted from the use of gasoline under a locomotive to expedite the work.

In overhauling the Diesels, only the safest equipment should be contemplated, and each employee should be taught the proper use of tools, lights, welding equipment, and fire protection. Safety and fire prevention should be made the habitual rule, and to accomplish this it is desirable that mechanics and supervision should be permanently assigned to Diesel repair work so they may be vigilant in the knowledge that they are working in hazardous surroundings.

Shop Design and Equipment

Diesel repair shops should be equipped with ample, well-maintained fire fighting equipment. Here, where water is available, water in fog form is an excellent medium of fire extinguishment, particularly because of the unlimited supply and the fact that most everyone is familiar with it. Where generators, motors and other electrical equipment are being repaired, carbon-dioxide, carbon-tetrachloride and dry-powder extinguishers are preferred, and several such extinguishers should be kept ready for use.

Dip tanks, impregnating vats, and bake ovens should be installed in separate fire resistive buildings and should be protected with fixed automatic fire equipment. If housed in one building, the several maintenance departments should be separated by fire walls, since each presents a hazard of its own. Fuel-oil fumes from the engine repair shop, varnish fumes from the electrical repair shop, and sparks from machine tools and acetylene or electric welding outfits in the body repair shop do not mix well together except when the admixture is in the correct proportions. Then they mix too well. Painting should be done in a separate building with adequate ventilation and preferably sprinklered. Portable fire extinguishers suitable for Class B fires should be available.

In the design of Diesel shops, the use of turn or transfer tables should be avoided and movable locomotives should be kept on not more than two continuous tracks, ready to couple, so that they may be removed from the shop building in case of fire. Each locomotive so removed, represents a saving of from $200,000 to $250,000, not to mention the consequential loss of use should the locomotive be damaged by fire.

Diesel locomotives should not be repaired or serviced in roundhouses. This type of structure was not designed for Diesel repairs. These locomotives are too valuable, intrinsically and potentially, to expose to adjoining live-steam locomotives. The servicing and fueling of Diesel-electric locomotives are entirely new departures from the old way in railroad life. It is so different from servicing a steam locomotive that the two operations should be kept separate as to location and personnel.

Fueling Stations and Procedures

Careful study should be given the fuel-oil installation, from the unloading device to the fueling stand. Much fuel can be saved and many fire hazards can be avoided by welding the pipe lines and using as few threaded joints as possible, by keeping the fuel lines above ground where they can be observed, by unloading tank cars through the dome and by moving the oil by positive-displacement pumps.

A typical fueling station would have the dome unloading device situated near the pump house and main storage tank with the pump connected so that it could be used to pump oil from the tank car into storage or from the storage tank to the fueling station, the latter operation being governed by remote control located near the fueling point. The difficulty presently encountered in fueling Diesel locomotives due to the oil-level gauge filling up while the oil is flowing into tank makes it necessary to cut off the flow of oil intermittently to observe the oil level. It generally results in the tank being overflowed in order to make sure it is full. The manufacturers either of the locomotive or the fuel-hose filling valve might be induced to incorporate in their design an air-escape whistle similar to that used by our armed forces on their blitz cans and by some manufacturers of gasoline dispensing valves and automobiles.

Oil spilled on ground should be covered with dirt until the oil is soaked up. Serious fires have resulted from the careless handling of cigarettes, matches, and open lights near where fuel oil has been spilled.

For the purpose of properly protecting fueling stations, each overhead unloading device, pump house, and fueling device should be equipped with one fire extinguisher suitable for combatting Type B fires. Such extinguishers should preferably be interchangeable with those used on Diesel locomotives, so that the locomotive can replenish its supply of fire equipment if it has been necessary to use it before arriving at the fueling station. The storage of replacement tanks for Diesel locomotive flooding systems at fueling stations should also be considered because it is important constantly to keep fire equipment on these locomotives in operation condition.

Fire Detection Systems

The detection of fires on Diesel locomotives is as important as the detection of low lubricating oil or hot bearings. Several devices are manufactured which detect either excessive heat, the rate-of-rise of temperature or the presence of smoke.

The excess heat detection through thermostats strategically placed in the engine room would soon sound the alarm and give the crew an opportunity to fight the fire in its incipiency—an important advantage. Such a system might not be effective under the locomotive due to varying weather conditions and wind created by the movement of the train. To detect fires underneath the locomotive, such as burning or smoldering oil residue or overheated traction motors, a smoke detecting device has been made that collects smoke present under the locomotive and by the means of photo-electric cells gives an alarm, enabling the crew to bring the train to a stop and engage the fire while it is yet small. Such a device has been tested on at least one locomotive. Unfortu-

nately, it was equipped with a disconnecting switch and the human element stepped in. So many alarms were received from passing burning crossties that the device was cut out, although it could be easily reset by merely pressing a button. Also, the sensitivity of this device could be adjusted by removing the front of the cabinet. Everybody tried to adjust it with heavy screw drivers until it finally got out of adjustment to the extent that it had to be cut out entirely.

The fact that everybody tampered with it trying to reduce the number of alarms is testimony that it worked well. A replaceable welded unit, factory set and unadjustable, with no disconnecting means and with reset button installed on the dashboard in front of engineman's seat is suggested as a definite means of detecting the presence of smoke under locomotive, an important warning, particularly for those roads that traverse country inaccessible by road.

Fire-Fighting Equipment

The first-aid fire equipment installed on Diesel locomotives varies considerably. Some roads use carbon-tetrachloride, others carbon-dioxide, while some use dry powder extinguishers. The use of water in fog form has been considered. Each of these extinguishing means is an effective fire fighter. Carbon-tetrachloride is somewhat at a disadvantage, only because in such confined spaces and prevailing temperatures it creates a pungent vapor which affects the user of the equipment to the extent that he can not continue his work.

Opinion as to the amount of fire protection to be installed also varies. Some roads use only one one-gallon carbon-tetrachloride or 15-lb. carbon-dioxide fire extinguisher per locomotive. Others use four of each. Some have fixed piped installations with deflector horns distributed over the engine room and a supply of 250 lb. of carbon-dioxide, which can be remotely released, to entirely flood the engine room.

The portable extinguisher is important, particularly in fighting small fires, and two such extinguishers should be installed on all locomotives. This may suffice the road operating through densely populated areas where public fire protection is available within a reasonable distance. But for roads operating where towns are scarce, a large supply of fire extinguishing medium is advisable.

For fires originating under the locomotive, experience has shown that carbon-tetrachloride or carbon-dioxide, except in bulk low-pressure form, or even dry-powder extinguishers, are unable to combat fire should the locomotive be standing in the wind, due to the dissipation of the Oxygen blanketing gases. The effectiveness of these fire extinguishing media is limited by the amount of chemicals available. Were it possible to carry enough of each or either kind on a locomotive, any size fire could be controlled. even under the worst circumstances. To combat this type of fire, foam is needed. This type of equipment is recommended, embodying a water-storage tank, carbon-dioxide propulsion tank, proportioning tank, remote controls, and two 100-ft. lengths of 1½-in. hose, one on each side of the locomotive, with a foam-play pipe on each hose. If a 120-gal. water tank is provided, approximately 2000 gallons of foam can be generated—enough to cover both trucks of a Diesel locomotive with a good smothering coat. Chemical foam is very effective, but mechanically created foam is preferred; it gradually dissipates, leaving little residue.

Another extinguishing system to be considered for underframe and truck protection is water in fog form. Such an installation would require a water supply tank, pump, piping and nozzles strategically located over exposed parts or one or more hoses with fog nozzles.

In either case, if water is to be used in fighting fire, a supply separate from that carried to feed the steam generators and sanitary system should be used. The fire-equipment water tank should be kept full always. The steam generator supply tank may be nearly empty at times and can not be depended on for fire fighting.

Periodically checking the fire equipment on Diesel locomotives is important.

Yard Protection

The application of fire protection apparatus to Diesel switching locomotives is, by reason of the confined space, limited to first-aid equipment, such as portable carbon-tetrachloride or carbon-dioxide extinguishers, and the possible installation of a flooding system of these same media for under-the-hood fires. One type available lends itself to the installation of a foam system such as proposed for the road locomotives.

Such equipment that is presently considered for switching locomotives does not nearly approximate the fire-fighting value of the steam switcher equipped with a fire hose. With the gradual disappearance of the old steam switcher, it will become necessary for those roads whose yards are not readily accessible to local fire-department equipment to devise and provide a fire-protection car equipped with water, hose, chemicals, tools and self-propelled pumping unit, which can be conveniently spotted in the yard where it will be readily available, so that the switcher can move it quickly to the scene of a fire. Several types of such cars have been developed, varying from old locomotive tenders, to tank cars and box cars. Each road can develop the kind that best suits its needs from old equipment on hand. Such fire-protection apparatus should be equipped to fight fires in three classes: ordinary combustible solids, flammable liquids, and live electrical equipment. Gas masks should be provided to protect personnel from the several types of exposures to which they may be subjected.

Above all, supervision and personnel should be trained and made thoroughly acquainted with the fire-protection equipment they may be required to use. For this purpose, an intensive training program should be planned, involving the actual extinguishment of simulated fires of the various kinds, by the men who will be called on to protect the equipment in case of fire.

Summary

Finally, the important details deserving serious consideration are as follows. Build Diesels so they can be cleaned. Keep them clean by giving the terminals a chance to clean them properly. Repair them safely in safe places. Fuel them properly without undue exposure. Equip them with sufficient and efficient fire-detecting and fighting equipment. Train the employees to forget the steam locomotive and all its associated methods. Realize that we are dealing with a valuable piece of equipment that is in itself a fire hazard.

GUSTAV METZMAN, president of the New York Central, has presented to the Smithsonian Institution in Washington, D. C., models of the original "Empire State Express," which went into service in 1891, and of the present train, which began operation late in 1941. The original model consists of the four cars which made the first run and locomotive 999, which established a speed record in 1893 of 112.5 miles an hour pulling the "Empire." The present-day model consists of six of a normal running complement of 16 stainless-steel, streamline cars and a streamline Hudson-type steam locomotive. A model of a two-unit Diesel-electric locomotive which succeeded the steam locomotive also was presented.

Behavior of

Wheels on Low-Adhesion Rails*

By L. D. Hays†

Fundamental factors involved in wheel sliding and effectiveness of wheel-slide-control devices analyzed — Differences in adhesion between new and old rail described

For many years, the practice in this country has been to design passenger-car brake rigging for maximum braking ratios of 90 and 150 per cent for full-service and emergency brake applications. The reason for selecting these ratios was that experience with higher ratios indicated that excessive wheel sliding occurred when the ratios of 90 and 150 per cent were exceeded.

Experiment has demonstrated that the coefficient of adhesion between a motionless wheel and the rail is about 32 per cent at the point of contact. While the wheel is in motion, the adhesion coefficient will become less and under ordinary dry rail conditions will vary from 17 to 25 per cent. With these adhesion values, passenger cars can be satisfactorily braked, utilizing braking ratios up to 150 per cent without sliding of wheels except for the last few feet of a stop. However, there are times when the wheel-rail adhesion is considerably less than 17 to 25 per cent and, as a result of heavy braking on such rail, the wheels are often flattened to the extent that it becomes necessary to remove them from service.

Causes of Wheel Sliding

The most common causes for slippery rail are frost, dew, a drizzling rain, leaves on the rail, a light dust mixed with moisture, insects, and newly laid rail. Sometimes even fertilizer drifts onto the rail when the farmers are plowing the fields. Intermittent spots of oil and grease, particularly at rail joints, switch points and on station platforms, do not help the cause along. These elements cause the coefficient of adhesion between the rail and wheel to fall as low as 5 to 7 per cent. This means that when braking on such low-adhesion rails, the wheels may slide at low speeds whenever a braking ratio of from 35 to 40 per cent is exceeded. In the words of the engineman, it would mean that wheels may slide whenever a brake-pipe reduction of more than 10 to 12 lb. is made on such rail without using sand to restore the adhesion to the higher values.

There are also two contributing factors which are present even during braking on dry rail. These are known as transfer of weight and intermittent wheel-and-rail contact.

A transfer of weight takes place from the rear to the front pair of wheels on a four-wheel passenger-car truck as a train stops with the brakes heavily applied. The front of the truck frame noses down while the rear of the frame appears to rise. This nosing of the truck creates a transfer of weight from the rear to the front axle of the truck. In addition, there is a transfer of weight from the rear truck to the front truck of the car. Mathematical calculations indicate the axle loads of a passenger car having four-wheel trucks and clasp brakes will change to approximately the following typical values when an emergency brake application is made while the car is in motion:

	Per cent of static load
On front axle	115
On second axle	88
On third axle	112
On fourth axle	85

Unfortunately, with the rolling car wheel, the wheel-and-rail contact pressure is of a variable and intermittent character. A casual glance along the surface of the track will disclose more or less undulating variations in it, the magnitude of which will depend largely on the character of maintenance and weather conditions. During cold weather, contraction of rails increases the joint spacing, and frost causes additional unevenness in the rail surfaces so that an emergency or even a heavy service brake application at high speed will often cause injurious wheel sliding.

While the wheel is subject to intermittent contact and non-contact at the rail, the rotative energy of the wheels helps to keep them revolving. At 60 m.p.h., the rotative energy will be approximately 200,000 ft.-lb. per pair of wheels. This, however, is not enough to prevent the wheels from sliding on low-adhesion rails when the condition of intermittent wheel-rail contact pressure combines with the transfer of weight and permits the brake-shoe pull to exceed the rail pull. These conditions account for occasions when only one or two pairs of wheels will develop flat spots even though all wheels under the car are subject to very nearly the same shoe pressure.

The area of contact between a 36-in. steel wheel and 127-lb. rail has been found to vary from .4 to .6 sq. in., which is an area about the size of a penny. The area of contact will depend upon the contours of the wheel tread and the ball of the rail, and the amount the rail bends at the point of contact. Various tests have demonstrated that the area of contact between the wheel and rail does not appear to influence the sliding of wheels.

Principles of Braking

Among the first and most important investigations to determine the coefficient of friction between brake shoes and wheels and between wheels and rails were those made in England in 1878-1879 by Captain Douglas Galton and George Westinghouse. It is interesting to observe that the results obtained during these experiments are considered most reliable data and have been confirmed by subsequent tests. The following principles established by these tests made 69 years ago apply with equal force to present-day conditions:

1—The application of brakes to the wheels, when skidding is not produced, does not appear to retard the rapidity of rotation of the wheels.

2—When the rotation of the wheels falls below that due to the speed at which the train is moving, skidding appears to follow immediately.

3—The resistance which results from the application of brakes without skidding is greater than that caused by skidded wheels.

4—Just at the moment of skidding, the retarding force increases to an amount much beyond that which prevailed before the skidding took place; but immediately after the complete skidding has taken place the retarding force falls down again to much below what it was before the skidding.

5—The pressure required to skid the wheels is much higher than that required to hold them skidded; and appears to bear a relation to the weight on the wheels themselves, as well as to their adhesion and velocity.

6—In order to obtain the maximum retarding power on a train, the wheels ought never to skid, but the pressure of the brake-blocks on the wheels ought to stop just short of the skidding point. In order that this may be the case, the pressure between the blocks and the wheels ought to be very great when the brakes are first applied, and ought gradually to diminish until the train comes to rest.

Automatic Wheel Slide Control

Experience has taught enginemen to avoid heavy service brake applications on low-adhesion rails, to consume more time

* From a paper presented before the meeting of the Air Brake Association held at Chicago September 15-17, 1947.

† Air-Brake Engineer, New York Central System.

when making station stops and slow-downs when tthe rail is slippery, and to make only light initial brake-pipe reduction in order to heat the wheels sufficiently to burn the frost off the rail before following up with heavier reductions. These precautions have been helpful when making service brake applications. However, with emergency applications, about the only thing that could be done to overcome partially low wheel-rail adhesion was to drop sand before the brake application, if time permitted. Now the railroads can afford mechanical devices that are available for the purpose of minimizing wheel sliding during braking.

Since 1937, three electrical and two mechanical types of wheel-slide-control devices have been offered for use on railway passenger cars. These devices function to reduce momentarily the braking forces on the wheels whenever they start to decelerate into a slip and thereby permit their resuming train speed. Automatic sanding on each truck of a passenger car is also available and can be associated with the wheel-slip-control device to sand the rail automatically following the first wheel-slip indication. This method of automatically controlling the sanding has the advantages of limiting the use of sand to occasions when actually required, thereby conserving sand, and it supplies the sand at the right time and place. When sand is applied after the wheels begin to slide, it usually will cause the flat spots to be larger than they would have been had the sand not been applied. Excessive use of sand is detrimental to track equipment and sometimes will interfere with automatic block signaling.

When the installations of wheel-slide-control devices first were undertaken, the New York Central System laid down thumb-nail specification having only two fundamental items, namely, (a) that in the event of possible failure or inoperative condition of this equipment, only the wheel-slide-control effect was to be temporarily lost without influence on normal functioning of the braking system, and (b) that ultimately the objective to be attained was that positive wheel-slide-control protection was to be obtained under emergency brake applications and unfavorable rail conditions.

As a result of a series of over-all check tests which we initiated and carried out in cooperation with the interested manufacturers, the above objectives not only were establishsed but also led to constructive simplifications being incorporated in the wheel-slide-control devices.

Wheel-Side-Control Devices Tested

Following four years' experimenting with all of the various types of wheel-slide-control devices on 32 modern streamline passenger cars used in Empire State Express service, the New York Central last year, in cooperation with two of the manufacturers, initiated a series of tests to investigate the possibilities of further improving the two most promising devices to provide maximum protection against wheel sliding and yet hold the stopping distance to a safe minimum. These investigations comprised one six-car train test and five series of single-car break-away tests, the last of which was completed on August 22. A total of 431 test stops were made over various rail conditions which included dry rail, dew on rail, artificially wetted rail, rail washed by rain, lightly sprinkled rail, dusty rail, and newly laid rail. Tests were made on well ballasted 127-lb. rail and on 105-lb. rail under which the roadbed was quite irregular.

Early during the development of the wheel-slide-control devices, it was realized that three paramount problems had to be solved; first, a reliable method for detecting the first wheel-slip indication, second, a very fast means for venting brake-cylinder pressure after the slip detection is relayed to venting mechanism, and, third, proper timing in the restoration of normal brake-cylinder pressure. These three difficulties became very realistic during our single-car break-away tests, wherein it was noted that with emergency brake applications at low speeds on quite slippery rail, the wheels went into slides at rates as fast as 80-100 m.p.h. per second. This means that the wheels ceased rotation in as little as .15 second and at the most required less than half a second. About one second is the minimum time yet achieved in venting the brake-cylinder pressure from 60 to 5 lb. Therefore, it is practically impossible to beat the wheel to a slide at all times. However, there were many times at higher speeds when the brake-cylinder pressure was vented fast enough to keep up with the slipping wheels and they were able to resume car speed without going into complete slides. Here again, the rail adhesion was the controlling factor when not low enough to permit the wheels outracing the dump valves.

During the wheel-slide tests, it was observed that when the wheels went into a slide, and the brake-cylinder pressure was vented, the time required for the wheeels to resume normal car speed depended upon the rail adhesion and the car speed at the instant. This time varied from .1 to .8 seconds.

Even though a pair of wheels goes into a slide for an instant and then recovers to car speed, that pair of wheels still provides some retarding effect due to resistance between the wheel and rail in the form of sliding friction and abrasion between the two metal surfaces. The fractional resistance is due to the relative roughness of the two surfaces in contact, and may be compared to the lifting of the weight to be moved over the successive inequalities of the surface on which it rests. Abrasion involves the cutting away of the particles of the metals in contact. Retardation is also produced in getting the pair of wheels back up to car speed as the wheels absorb some of the energy of the moving car in doing so.

Effect of Rail Age on Adhesion

Last year the New York Central experienced several cases of flat wheels on passenger trains on account of the brakes being applied while the trains were on newly laid rail. This led to our making single-car break-away tests to determine the difference in adhesion between new and old rail, and to see how much traffic and time was required to wear the new rail down to a good adhesion surface. It was found that new 127-lb. rail which was heavily coated with mill scale provided a minimum adhesion coefficient of .12 when the rail was dry. After about 18 freight trains had passed over the new rail during the first 24 hours in service, it was noted that the adhesion coefficient increased to a maximum of .16. This indicated that the adhesion of new dry rail may be as much as 25 per cent less than dry worn rail due to the coating of mill scale always present on new rail; also, that one day of ordinary traffic was sufficient to wear the new rail down to a surface capable of providing rail adhesion equivalent to that of well worn rail.

Upper, section of newly laid 127-lb. rail over which no trains have run; lower, the same rail after 24 hours of traffic

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Surplus Troop Cars.—Of the 506 surplus troop sleeping cars sold by the War Assets Administration, 105 were purchased by railroads, and the others largely by the Reconstruction Finance Corporation and Warner International Company of Chicago. The Chicago, Rock Island & Pacific and the St. Louis Southwestern bought 50 each, the Bangor & Aroostook purchased four and the Minneapolis, Northfield & Southern bought one. The cars purchased by the Rock Island cost $3,780 each and all the others cost $2,880 each.

Welding in Car Repairs*

By H. E. Gannett†

Factors affecting the success of welds include faulty design of the part and porous parent metal — Test results of procedures under Rule 23

About 30 years ago, fusion welding processes were being introduced and accepted almost entirely as a repair process on railroads. All of you who were familiar with the inception of these processes will remember old types of equipment and welding materials, and realize how far we have been privileged to advance since then. Generally speaking, railroads have been cooperative in conducting practical tests of many new equipment and material developments.

Actually a weld is nothing more than a means of transferring stress from one part to an adjacent part. Abrasive-resisting weld deposits are not, of course, covered by this definition. Therefore, in welding, the proper unit of appraisal should not be the lineal inch, as is so often used.

The true value of a weld joint is the cross sectional area of the weld metal completing the joint. If you develop in a weld metal section less cross-sectional area than that of the adjacent parts to be joined, a notch effect is created which will greatly reduce the operating effectiveness. Likewise, if an abrupt heavy weld deposit reinforcement is developed, the point at which the abrupt section change is made will have concentrated stress, thus impairing its operating effectiveness. If the safety factor of a given member is high enough, it should be understood these objectionable conditions carry a lessened liability. Bear in mind there is no other process or procedure that can produce equal strength on continuity in a metal joint.

We have been able to develop procedures by which many parts can be welded with dependability so far as the process application is concerned. No matter what type of welding process is involved, the skill of the welding operator remains as a last necessary requirement for a successful welded unit. Considering the source of major research contributions, it is highly desirable to encourage qualified supply representatives to pass their valued developments on to railroad representatives and welders as soon as consistent, so as to maintain welding efficiency at the highest possible level. Most railroads have welding specialists, in whom welding procedure control is vested, but an organization is required on a large railroad to keep welding operators well informed, as the job itself is primarily where welding dividends accrue.

Welding Operators Make Real Contribution

At this point I would like to pay just tribute to faithful welding operators usually referred to as a "welder," for their contribution to the advance of the art. For over 30 years, it has been my privilege to be directly or indirectly associated with welding, and I have never met a welder who wasn't aggressively interested in making a perfect weld. That is his ambition.

It is a matter of added economy and will facilitate the rapid return of a car to service by welding parts in place, where permissible. We all know there are times when over-ambitious supervisors direct the welder to perform work under extreme difficulty; for instance, by not removing parts which act as obstacles to his necessary manipulation. Each condition of this nature should be given cooperative consideration. I have found that you can depend on a welder to do his best, but you can't afford to discount the obstacles he faces.

Welding materials in a broad sense are quantitative, but a welder's ability is primarily qualitative. As an example, you should not expect a welder to produce a welded joint capable of resisting an 80,000-lb. stress, if you give him 50,000-lb. filler rod material. His qualitative requirement is only that he have the ability to control the molten metal in making a joint with uniformity and precision. He should not be blamed for failure if he is directed to weld or braze materials that do not lend themselves to fusion or adhesion, or to perform a job with the wrong process or materials. That is why the A. A. R. welders' qualification test is strictly on the basis of a welder's ability to control molten metal. It is a responsibility of mechanical authorities to specify the type of weld metal to be used on a given part, also to insure that short-cut substitutions are not forcibly used.

The most common metals used in car structures are mild steel plates and shapes, Grade B cast steel, malleable iron and an increasing amount of low-alloy high-tensile steels. Some few Grade C and D steel castings and a little aluminum are also used. Each of these materials requires the proper filler rod material to duplicate as closely as possible the physical properties of the respective materials to be welded, except of course, the areas normally subject to abrasion, in which instance a specific type of weld metal may be applied at least to reduce the rate of abrasion, thus prolonging the service life of that area.

Repair Track Welding Mostly Manual

Proper preparation of a part to be welded is prerequisite to an economical and sound weld joint. Your production will be decreased in direct proportion to the excess joint opening and the cost will increase in approximately the same proportion. Practically all repair-track operations are manual and there are little or no usable applications of the deeper penetrating processes, such as submerged melt, by which the fusion of the deep portions of plates is accomplished with little or no added weld metal. The maximum advantage to repair welding in this respect are the deep penetrating manual electrodes, where conditions indicate their use.

At this point it appears that the word "Autogenous" should be defined because of its misuse. A definition of autogenous as applied to welding is: "Uniting metal surfaces by fusion without hammering and without the addition of metal." The title "fusion welding" is now

* Abstract of a paper presented at the April 14 meeting of the Car Foremen's Association of Chicago.

† General welding supervisor, Chicago, Burlington & Quincy.

universally used, because it is broad and includes the operation whether metal is added or not.

When the usual electric-arc or oxy-acetylene welding equipment is used to apply bronze or brass to form a joint, it is referred to as "bronze welding" and implies that the metal parts (if made of steel, cast iron, cast steel, etc.) are attached by adhesion, and not fusion, at least to no appreciable depth.

Another major factor, definitely not a welder's responsibility, is the faulty design of a structure. Polarized-light studies of various types of joints as originally made by Professor Hollister at Purdue University have given us the visual picture of areas of concentrated stress in a weld joint. It seems that this practical demonstration and visual result should be publicized far more than it has been, because it has to do with every welding job where transfer of stress is concerned. This relatively simple test can immeasureably help you understand the most destructive errors in weld joints and it should be thoroughly understood by the engineer who designs a welded structure. Stress-coat is another practical method which provides a visual picture of stress analysis.

When a part is to be repaired or reclaimed by welding, we are interested in its continued successful performance as a unit. A failed welded part is a weld failure even if the part fails outside the weld metal, whether due to destructive effect of welding heat in the parent metal, or due to porosity in close proximity to the weld if it is identified during the progress of the weld. We should always keep in mind that the weld and weld effect must not cause further failure of the part. These latter statements are to be accepted with reasonable judgment insofar as porosity is concerned. Certainly a welding operator cannot accept the blame for all the porosity contained in a cast-steel section.

A. A. R. Specifies Porous-Free Castings

A. A. R. Manual under Spec. 201-45, Sec. IV, Par. 15 (b) specifies that steel casting must be free from injurious defects, as compared to A. A. R. Rule 3 which on page 24 (t) (3-C) states that cast-steel truck sides must be entirely free (among other things) of porosity. A. A. R. Rule 23, Page 95, under the truck-side limitations rule is, in the first paragraph, making a move to eliminate the cast-steel truck sides cast prior to 1927. This decision was prompted by the large amount of irregularities contained within the cast-steel sections, principally porosity, it being thought that a major improvement was evolved in the latter part of 1926. Regardless of whether or not the year 1926 produced a major improvement, it is a fact that since that date, we still have prolific porosity in this material; it is impossible to obtain strength from gas bubbles. The disturbing part is that this porosity and "injurious defects" are usually not externally visible. X-ray photographs will reveal them, but this is not a usual procedure.

The reason this serious condition is brought up in a welding subject such as this is two-fold. First, according to A. A. R. Rule 3, any truck side removed from a car and welded for replacement stock must be entirely free from porosity or it cannot be replaced in service. I do not wish to deceive myself, and frankly, would not be willing to say that any truck casting is entirely free from porosity, even if I visually inspected it to the best of my ability. If an X-ray inspection revealed the section to be sound, I would be more willing to accept it, but what railroad is equipped to conduct such extensive testing?

The second reason is the difficulty of eliminating or removing such defects when they are encountered during the progress of a weld and how can we be certain they have all been removed when weld repairs are completed? In a few instances in Rule 23, a U- or J-groove preparation is specified in connection with making a weld. Also on truck sides, an oxy-acetylene gouging nozzle is specified to prepare the U-groove. The reason for this requirement is, that the gouging nozzle is a good inspection tool for disclosing irregularities in metal due to its washing effect, which does not upset the metal as does a chisel, which tends to cover up irregularities. It also has the natural ability to leave a U-type groove. A J-groove is simply one-half of a U-groove. The U-groove importance to a weld is, that it permits maximum surface area to absorb heat with a minimum root section area which, in turn, permits the easiest root section fusion. As the root section is fused, the contraction of the cooling metal causes considerable shrinkage stress, and with thinner adjacent parent metal thickness, stress is not nearly so concentrated in the fusion zone, because the thinner section yields and the dissipation of heat is not so rapid from the weld zone; also as heat dissipation takes place, the adjacent thinner section tends to expand, compensating for the shrinkage of the weld zone.

The U preparation was originally a patented process. Other than preheating, this is the most reliable preparation to insure weld-root fusion, which is a most necessary requirement for a satisfactory weld.

First Consideration Given to Safety

In preparing the A. A. R. code of rules, the committee responsible for formulating the rules must of necessity give first consideration to the safe continued performance of each welded part. Opinions as to dependability of welding do not always coincide. It is perfectly natural and no doubt healthful, that variations in opinions exist, providing the analysis of the problem is correct.

Usually the rejection or acceptance of a welding operation by the A. A. R. is first decided by a specific mechanical committee or sub-committee, assigned to certain functionally connected groups of car parts. For the most part, decisions of these committees are based on the potential liability that may accrue in case of failure. An example of prohibited welding is that part of Rule 23 covering U. S. Safety Appliance standard parts. Some of the welding prohibited in A. A. R. Rule 23 is no doubt a carryover from the infancy of the art, when undeveloped equipment and materials, untried techniques and untrained operators resulted in failures which left the impression that certain wearing conditions do not lend themselves to successful welding. Several restrictive examples are as follows: (1) Cast-steel bolsters worn over 40 per cent of their section area; (2) coupler shanks worn in excess of 3/8 in. deep; (3) coupled yokes, if worn in excess of 1/8 in. and 20 per cent of the cross sectional area of the strap; (4) spring or bolster hangers, if worn in excess of 20 per cent of the original section.

These case examples have proved themselves sufficiently strong by having worn to the extent indicated without fracturing. The materials they are made of can certainly be equalled, if not exceeded, in physical properties by weld deposit metal restoring the worn area; it follows that the restoration of worn surfaces would correct a much more destructive eccentric load condition. Further, a weld metal of higher abrasive resistance can be applied, which will insure a longer performance record than that of a duplicate new part.

It appears from these simple examples that a better advantage of welding procedures can be taken by specifying the use of adaptable abrasion resisting weld material. Many cast or rolled sections of ferric structural material

do not contain all of the desirable characteristics in the as-rolled or as-cast condition, and welding processes are admirably adapted to the possibility of advantageous alterations, the outstanding of which is hard surfacing. The welding procedures required to deposit wear-resistant materials on the bulk of the general run of steels are relatively simple. On medium- and high-carbon steels the relatively cheap flame-hardening procedure will, in many instances, provide a much-improved, wear-resistant surface structure. Almost all surface areas subject to heavy abrasion are locally subject to compressive stresses; under this operating condition there is a greatly lessened liability to rupture the main body of metal, due to the hard-surfacing materials. The selection of the most efficient hard-surfacing weld material should be given cautious consideration because of the various factors involved. It is an economic error to ignore the value of abrasive-resisting weld applications, even on new parts, where it is known abrasion will take place.

A further major consideration is the economical justification for progressing any welding repair operation. The magnitude of car welding operations specifically mentioned in the A. A. R. Rules is more impressive when an estimated total of the more important parts are tabulated. Presently, there are more than 2,000,000 freight cars of all types in interchange service. Considering only truck bolsters, top center plates (most truck bolsters of later design have the bottom center plate cast integral), couplers, yokes, spring planks, and truck sides, there are approximately 30,000,000 such parts in interchange service, with a total new value of about $750,000,000. Adding the value of the underframes, superstructure, etc., where there is practically no restriction on welding operations, the total value of parts within the applicable field of welding must be over $3,000,000,000, on interchange freight cars alone.

Large Economies Possible By Welding

The question naturally follows, What net return is accrued from the cost of welding? Any answer would have to be broad, but it seems from surveys of cost ratios that for each dollar spent on welding operations the railroads can expect at least a net return of $2.00 over and above any competitive process. In other words, any railroad spending $1,000,000 a year on essential and practical operations, could reasonably obtain a net return of $2,000,000. With so large a volume and value involved, it becomes clear why rules pertaining to welding should be under close scrutiny and be revised currently to take advantage of all progressive developments. These figures do not include the value of continuity of car service due to expeditious repairs by welding and no attempt is made here to analyze this added monetary return.

There will be times when the cost ratio of reclamation compared to the cost of a new part is not the controlling factor—for example, during the recent war period when it was, at times, impossible to obtain new materials. This condition necessitated the adoption of Sec. C, first known as an emergency section of A. A. R. Rule 23. The complete revision of Sec. A and B of Rule 23 several years ago was due to the estimated future demand of an anticipated war emergency, also an effort more nearly to take advantage of the progress made in welding to that date.

It is generally understood and true that some A. A. R. welding rules are formulated as the result of laboratory tests. During the years 1942-43, A. A. R. tests were conducted of welded cast-steel coupler bodies, coupler yokes and truck sides. The specimens used in these tests were all of Grade B cast steel, identical to the majority of similar parts now in service on interchange cars.

You who are charged with the responsibility of handling and welding these parts should know that a well-defined welding procedure was followed to produce a number of the welded specimens involved in these tests, along with test specimens of other welding procedures. The details of procedures followed in preparing these test specimens were submitted in letter form to the A. A. R. in August, 1942, when these test specimens were prepared, and are a part of the A. A. R. file. In these tests the defined procedure specimens exceeded the strength performance of all other specimens tested. The following comparative tensile load figures taken from the test records speak for themselves: Cast-steel yokes, defined procedure, (3) 590,000 lb., (2) 628,000 lb., (1) 660,000 lb.; cast-steel yokes, highest of all other procedures, (2) 517,000 lb., (1) 532,000 lb.; cast steel coupler bodies, defined procedure, (3) 575,000 lb.; (2) 622,000 lb., (1) 631,000 lb.; cast steel coupler bodies, highest of all other procedures, 500,000 lb.

The defined procedure exceeded other procedures by as much as 131,000 lb. in a single unit, with a minimum higher comparative test performance of 58,000 lb. Six specimens of the defined procedure were tested, compared with three specimens of the best other procedures submitted.

The defined procedure referred to is not permitted for use on cast-steel coupler bodies and yokes under present A. A. R. Rule 23.

The test performance records and reports were submitted to the A. A. R. Coupler and Draft Gear Committee and the General Committee of the Mechanical Division.

Shortly following these tests, the A. A. R. also conducted test of welded truck side frames. The couplers and yokes are made of the same Grade B cast steel as truck side frames.

Four new truck sides that had previously been tested to destruction were set up as standards for comparison. Each of them had failed through porous sections, failures being attributed to such weakened area.

In the truck side tests the same defined procedure was specified and used as on couplers and yokes. This procedure performed perfectly on side frames also, and is now approved for use on truck side frames in A. A. R. Rule 23. A part of this defined procedure, namely the use of an oxy-acetylene gouging nozzle in preparing a U-groove, is a must in Rule 23 for any processes of welding on truck side frames.

Most Freight-Car Metals May Be Welded

Fortunately, almost all of the metals generally used in freight-car construction lend themselves to welding applications. A vast proportion are in the low-carbon range known as hypobutectoid steels which, in other words, are steels with a carbon content .83 per cent or lower. As a general rule, the higher the carbon content the more critical a successful welding procedure must be. Structural-steel shapes and plates usually are within a carbon range of 0.15 per cent to 0.25 per cent and present little difficulty. Grade A steel castings range close to 0.20 per cent carbon and this carbon content gives little trouble in welding. The Grade B carbon range is about 0.33 per cent and at this point it is necessary to use a procedure that will moderate the undesirable high-temperature effect of welding.

The few Grade C and D castings used in car construction usually have carbon ranges bordering 0.45 per cent, or are composed of alloys. Both are extremely

(Continued on page 694)

The Load Compensating Brake*

By C. D. Stewart†

THE Illinois Central Railroad is about to place in service 400 hopper cars equipped with the new Load Compensating Brake, which, by a unique piston arrangement, makes it possible for the first time to produce varying braking forces with a single brake cylinder. In this way the extra weight and handicap of a second brake cylinder with its notched push rod and latch box is avoided. This arrangement, also for the first time, employs less air for braking a loaded car than for an empty car—a very desirable situation.

To obtain the necessary braking force for the loaded car the single cylinder is 12 in. in diameter, and to conserve air the nominal piston travel is 5 in. This compares with 8-in. nominal piston travel for the single capacity brake and with 8-in. piston travel for the empty cylinder and 3-in. for the load cylinder of the empty-and-load brake. To better insure the desired piston travel at all times an automatic slack adjuster is employed. This also is the first time that the slack adjuster has been considered to be an indispensable part of a freight brake equipment.

The sectional view of the brake cylinder, Fig. 1, reveals the points of interest in its design. The brake cylinder body is of conventional design. The piston, however, has in addition to the conventional 3-in. diameter hollow rod, a second hollow rod 7⅝ in. in diameter. This larger hollow rod in conjunction with a sealing gland in the non-pressure head forms an air chamber on the spring side of the 12-in. piston. The chamber inside of the hollow rod, *c*, is always subjected to atmospheric pressure. The chamber around the hollow rod, *b*, is subjected to pressures ranging from atmospheric to the maximum developed in the chamber of the 12-in. piston, *a*.

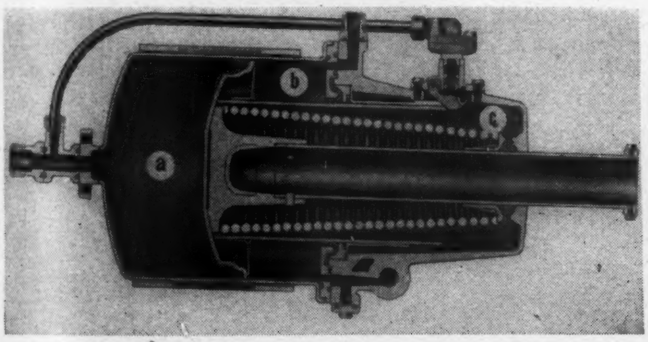


Fig. 1—The brake cylinder body showing the 12-in. piston, a; the chamber around the hollow rod, b; and the chamber inside the hollow rod, c

The air under pressure in *a* is that which produces the braking force, and the degree of braking is produced by the amount of service brake reduction or by an emergency application, in the conventional manner.

The air under pressure in *b* counteracts the pressure in *a* in proportion to the respective pressures and piston areas in the two chambers. If the car is fully loaded, the pressure in *b* will be atmospheric at all times. If the car is empty, the pressure will be the same as in *a*. When the car contains intermediate loads, the pressure will differ from that in *a* in proportion to the loading.

† Vice president, Westinghouse Air Brake Company.

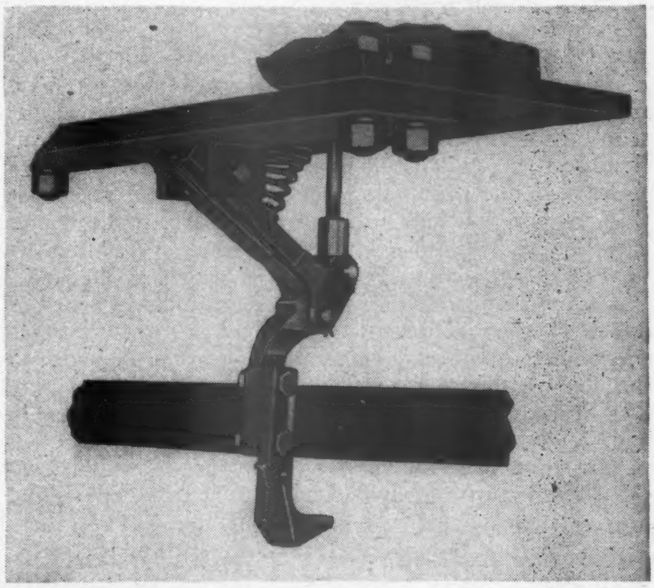


Fig. 2—The weighing gear in its non-functioning position

The "effective" piston area for the empty car condition is capable of producing a 50 to 60 per cent braking ratio with 50-lb. brake cylinder pressure. The "effective" piston area for the loaded car condition is capable of producing approximately 30 per cent braking ratio with the same pressure.

Thus the range of braking ratios is much narrower than with the single capacity brake and consequently the slack producing forces in mixed trains is very much reduced. As for solid loaded trains, the braking ratio is 50 to 100 per cent greater than is now obtained on trains having the single capacity brake and, therefore, the brake is very much more effective for the control of trains on

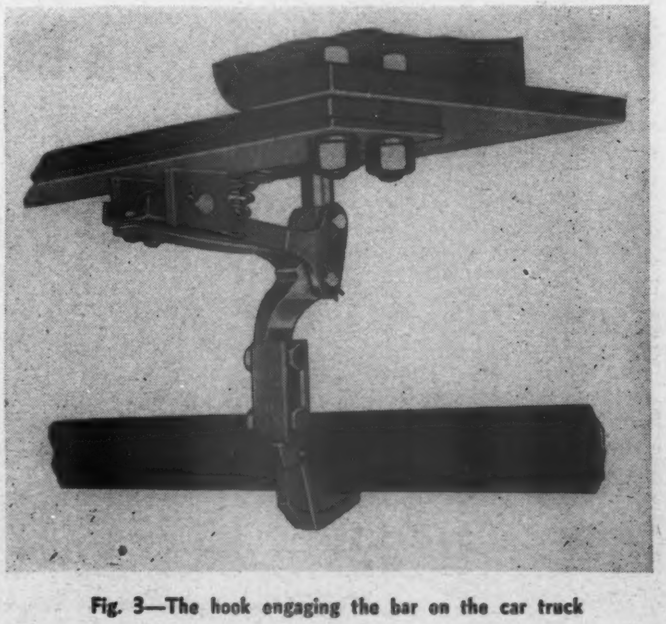


Fig. 3—The hook engaging the bar on the car truck

heavy grades or for trains operating at higher speeds.

Since the brake cylinder will have air under pressure in both chambers *a* and *b* under certain condition of car loading, it follows that air for operating the automatic slack adjuster cannot be taken from it in the conventional way. To meet this situation a cam-operated valve is mounted in the non-pressure head in such a location that the large hollow tube engages it at the point of nominal piston travel. The valve is opened by any hollow rod movement beyond this point and air under pressure from chamber *a* causes the slack adjuster to function in the conventional way and thereby takes up the slack in the brake rigging restoring the piston travel to normal.

The degree of air pressure that is admitted to chamber *b* is determined by the load compensating valve and it in turn is automatically adjusted by the weighing gear. The gear is normally in free position so that car body movement due to running over the road will not cause false registration and also will not wear out the equipment. Fig. 2 shows it in such position. When the car is at its designation and having been loaded or unloaded, the locomotive is again attached, the brake system is of course charged before the car is moved. In the processes of building up the air pressure from atmosphere to 45 lb., the weighing gear momentarily comes into action. The hook is raised, engages a bar on the car truck, Fig. 3, and thereby causes the mechanism in the compensating valve to assume a position that corresponds to the deflection of the car springs that in turn reflects the degree of car loading. When this function has been performed and the brake system pressure rises above 45-lb., the weighing gear is disengaged and the compensating valve locked in the position to which it has been moved.

Fig. 4 illustrates the scale beam mechanism within the compensating valve. Reference *d* is the movable fulcrum that is positioned by the weighing gear in conformity with the car loading. Reference *e* is a plunger that creates a force on the right hand end of the scale beam, reference *f* when air under pressure is present in chamber *a*, which is connected at all times with chamber *a*

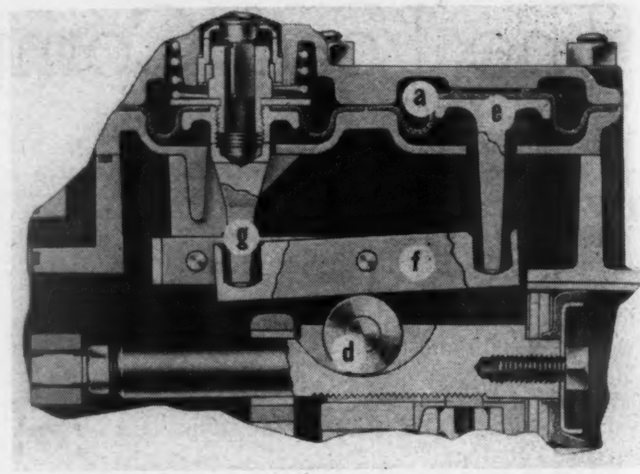


Fig. 4—The scale beam mechanism within the compensating valve

of the brake cylinder. The amount of force that is exerted at *f* is in direct proportion to the brake application and the amount of force that is delivered at *g* is in proportion to the location of the fulcrum *d*. In the position shown the fulcrum is in the middle of the beam and consequently the forces at each end of the beam are equal. The upward movement of the left end of the beam opens an air supply valve that permits the flow of air from the compensating reservoir to chamber *b* of the brake cylinder, and, because the forces on both ends of the fulcrum are equal, the pressures in both chambers of the brake cylinder will be equal. The effective braking force, exerted on the brake cylinder push rod, is that developed on the brake cylinder piston area; that in chamber *a* is not opposed by a like pressure in chamber *b*. When the car is fully loaded the fulcrum is directly under plunger *b* and there then is no force delivered to the left end of the scale beam. As a consequence there will be no air under pressure transmitted to chamber *b*.

(*Continued on page 695*)

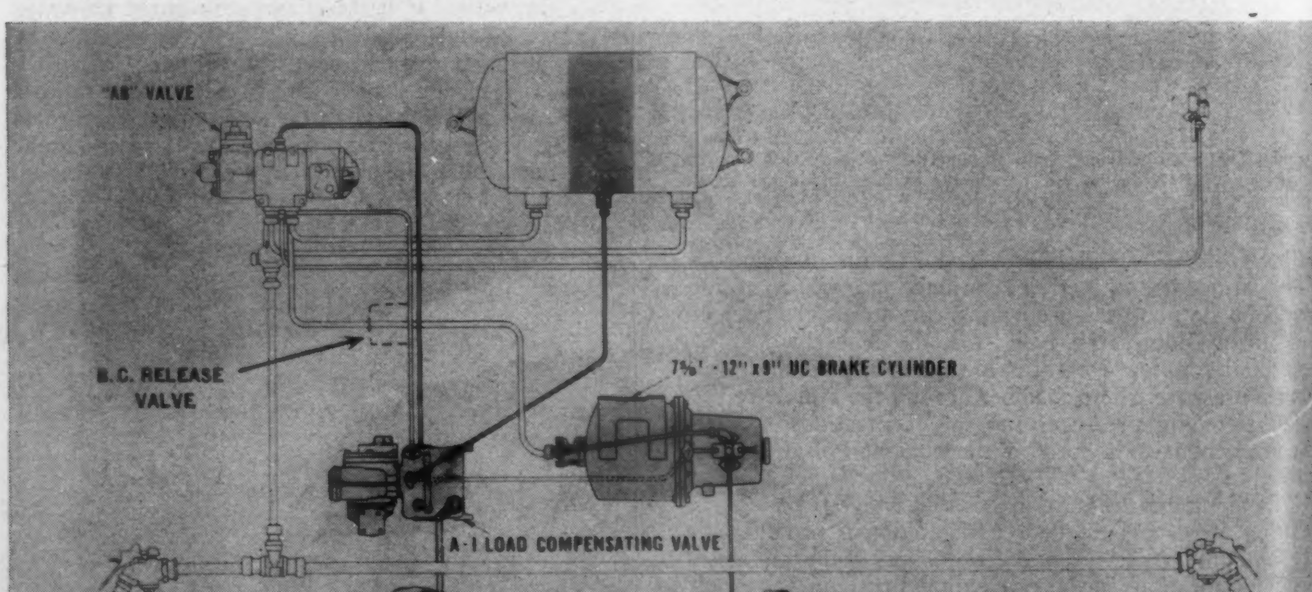


Fig. 5—Piping diagram of the complete Load Compensating Brake equipment

Diesel Operating Traits*

By P. H. Hatch†

They spring primarily from characteristics of direct-current series traction motors and a fixed power input

A revolution in railroad motive power has taken place. It is fair to say *has* taken place, rather than *is* taking place. The dictionary defines "revolution" as a radical and unusually sudden change, and certainly by that definition the Diesel-electric locomotive has caused a revolution to take place.

There are few in this room who will take issue with me when I say that Diesel-electric locomotives are the dominant factor in railroad motive power and are largely supplanting other types. The operation of these locomotives covers an exceedingly wide field, far wider than I can hope to cover today, so I shall try to pick out for brief presentation one or two of the principal characteristics of this locomotive as it affects operation.

Notice that I have used the term "Diesel-electric locomotive," rather than "Diesel locomotive." There are two ways to consider the electrical feature on a Diesel locomotive. One is that it is an electric drive or transmission—a necessary evil, but we have to have it to use the Diesel engine. The other way, and the one which I prefer, is the term "electric locomotive with a self-contained Diesel power plant."

P. H. Hatch

Diesels Inherit the D. C. Traction Motor

The characteristics of the Diesel-electric locomotive in all important respects except one are the same as for electrical locomotives. Where the Diesel lacks this one characteristic, it more than makes up for it in others. The one characteristic lacking is the high short-time overload capacity of the electric locomotive.

Our latest freight electric locomotive on the New Haven has a continuous horsepower of 4,860. For short periods, that locomotive can go up to 9,000 hp. There is no Diesel locomotive nor any other locomotive type built that can touch a performance such as that. But the Diesel-electric locomotive, unlike its electric-locomotive cousin, can go anywhere on the railroad where clearances and weight permit, independently of power supply. If you want to find out how important that it talk to some operating men after there has been an outage of power supply due to a sleet storm or lightning storm.

The most important single feature of the Diesel-electric locomotive is the direct-current series motor. The best way to describe what this motor does is to say that the slower it goes, the harder it pulls. That is contrary to the older types of motive power with which you are familiar. Whereas this is a big advantage in preventing stalling and in starting and bringing trains up to speed quickly, it nevertheless has a disadvantage just around the corner. At the very low speeds, the current goes way up and then becomes limited by traction-motor overheating. We had a rather interesting example in the early days of operating this first switcher on the New Haven I mentioned a while ago. It was first put in service in a small yard in the New Haven territory, and at the end of the first trip, it was customary for a heavy 8 wheel steam switcher to come down and haul the drag up to Cedar Hill Transfer, a run of two miles. In testing this Diesel down there, we wanted to see what it would do. Finally we persuaded the operating department to let the Diesel haul the transfer drag up to Cedar Hill. Playing somewhat cautiously, they had the steam locomotive follow us up closely. We got started all right, moved up the main line through a series of crossovers and somewhat of a grade and the Diesel began to slow down. It slowed down to where you could walk along side of it. As we know now, there is nothing to worry about, providing it doesn't last too long. When the Diesel is going slow, it is laying back its ears and doing real hauling. In the early days before we recognized that, we thought we were getting the best results when the speed picked up and the current dropped. During the test, we found that the steam locomotive had been coupled on the rear and was helping us. That spoiled the test. I could mention a number of examples, all of them interesting, and even cases where trains have stalled on heavy grades with Diesel-electric power and got out of the place where they stalled. We haven't seen much to worry about in respect to traction. This characteristic has been the hardest to learn on the railroad.

The Diesel locomotive differs from other types in that it is a constant-horsepower machine over its entire speed range. By means of the electric-locomotive characteristic of the Diesel-electric you can translate that horsepower into a high tractive force and low speed or high speed and low tractive force.

An All-Purpose Locomotive

This characteristic, by and large, makes a more dependable locomotive from the standpoint of schedule and from the standpoint of handling full tonnage in winter weather. Last year, for the first time, we gave up reduced ratings in cold weather in freight service for Diesel electric locomotives, with some misgivings. We held full tonnage trains throughout last winter with the Diesel-electric locomotives in good shape.

The Diesel-electric locomotive, in common with the electric locomotive, has led the way as an all-purpose, interchangeable locomotive. A number of years ago, anybody who talked about a locomotive that would handle the fastest passenger train and the full tonnage freight train was talking about a beautiful dream—it didn't exist. We have a 4,000-hp locomotive, running up to 80 miles per hour on a limited from Boston to New Haven, which goes back to Boston on a 4,500-ton freight train. That has been going on since 1941 and is no longer an experiment.

In the last few years the D. C. traction motor has been made to serve still another purpose. That is by using the motors as generators, it is possible to brake trains by the so-called dynamic

* From an address presented before the meeting of the Railway Fuel and Traveling Engineers' Association at Chicago, September 15-18, 1947.
† General Mechanical Superintendent, New York, New Haven & Hartford.

brake principle. With the latest type locomotives which have the dynamic braking feature it is possible to operate tonnage freight trains from one terminal to another without the use of air brakes at all except for train stops. This has a most important effect in train operation, both as to saving time and in eliminating car failures. Going down grade, we lose more time than going up. With Diesel, we find that we are saving part of time going down grade and yet the maximum speeds are low. We are able to use a higher average speed, but the maximum speed is below what it was previously with air-brake operation.

Crew Comfort

The Diesel-electric locomotive has produced equally important and I might say radical results in the greater comfort and ease of operation for the engine crews. Time and again I have heard the remark on the part of enginemen that operating a Diesel-electric locomotive has added years to their life.

The Diesel-electric locomotive has created problems of supervision and instruction of engine crews on the part of road foremen. I have tremendous admiration for the way you men have arisen to this problem and have met it.

Simplicity and Accessibility

The builders and the railroad mechanical engineers can help out tremendously in instruction, supervision, and operation of Diesel-electric locomotives if they will forget theoretical but remotely needed protection and theoretical efficiencies which don't amount to much and concentrate on simplicity and accessibility of apparatus. No doubt every railroad that has operated Diesel-electric locomotives has gotten tied up time and time again because of the blowing of a small fuse. Let's try to perfect what we have, stressing simplicity and accessibility, and forget about the unnecessary refinements.

Discussion

A number of questions were asked of Mr. Hatch pertaining to operations and maintenance of Diesel locomotives and training of crews. These questions, with the answers, follow.

Q.—What is to be done when there is a loss of power on a Diesel locomotive in freight service? A.—Reduce the tonnage.

Q.—What is the best temperature at which to run the motors? A.—The lowest possible temperature. Do not operate the locomotive to extremes of low to high temperatures too frequently; the expansion and contraction affects the life of coils and other parts of the motor.

Q.—What should the engineman know about the Diesel locomotive? A.—He should know enough to get out of trouble on the road. He should also be encouraged to acquire as much general knowledge of the locomotive as possible.

Q.—Should a railroad repair its own motors? A.—The New Haven repairs them in its electric locomotive repair shop. The answer depends upon the number of locomotives to be repaired.

Q.—Who are the instructors on the New Haven? A.—The traveling engineers and six instructing enginemen.

Q.—Does the New Haven use riders on its Diesel locomotives? A.—No road maintainers have ever been employed on the New Haven.

Q.—In case of man failure, who is held responsible? The engineman or fireman? A.—When the locomotive is in motion, the engineman is not responsible for what goes on back of the cab. When the locomotive is standing, both men are responsible.

One of the training problems which was mentioned in the general discussion is the loss of men trained for Diesel operation who bid in better steam jobs. In training men for Diesel service on the New Haven an eight-step instruction sheet is given to each road crew. Each step is used for a single trip and the men sign the sheet for that step at the end of the trip. Then, three men and an instructor spend four hours together creating defects with an oral examination at the end of the period. This is done on the locomotive and leads to a competency certificate. The men are paid for this time. If they require re-examination, they must do it on their own time.

Another problem which complicates the training program is the variety of locomotives on some railroads which makes it impossible to put out a single set of instructions to cover all locomotives.

Welding in Car Repairs

(*Continued from page 690*)

sensitive to welding applications and must be welded with specific procedures.

High-manganese steel, sometimes used as wear plates, has a carbon content of near 0.85 per cent and is alloyed with about 13 per cent manganese which makes it an Austenitic type of steel. Austenitic steel in its relation to welding, has no abrupt critical transformation and therefore it does not develop an abrupt volume change such as ferric steels do.

Ferric materials of the next higher carbon content which we generally use are within the cast-iron category, which have a carbon content of around 3 to 3.6 per cent, or about four and one-half times as much carbon as the highest steel generally used. In principle, if this material is subjected to long periods of heat as high as 1,300 to 1,600 deg. F., and is slowly cooled, it becomes malleable iron and is comparatively soft and ductile. When it is heated to the above temperatures and then cooled rapidly, it becomes hard. The white cast irons are markedly harder than the grey cast irons under all comparable conditions of heat gradients. As a matter of fact, an improved condition will result if steels of the lower carbon content are at least warmed to as low as 200 deg. F.

A preheat temperature of 400 deg. F is generally desirable for medium carbon steels, whose range is around 0.45 per cent carbon. Proper preheating tends to eliminate the possibility of internal thermal checks which are, in fact, cracks. If these thermal checks have accrued, any subsequent heat treatment does not remove them and they remain as very definite injurious defects.

If these simple expedients are followed it will be the first step in the dependability of a weld. The different ferric metals vary in their inherent ductility and those with low ductility are adversely affected to a greater extent by the local high temperatures of welding. Preheating tends to eliminate the first shock but it is not all that is necessary if the material is not high in ductility. Depending on the critical nature, we can follow the weld procedure with stress relieving by heating the generally affected area to 1,100 deg. F., which tends to permit local plastic flow at areas in and near the weld so that little residual high stress remains at a sharply defined location.

If, after welding, we wish to restore a higher uniform strength to the part, we can normalize by heating it to around 1,600 deg. F., which will make the material structure more uniform, and then, by permitting it to cool under the same conditions as those under which it was manufactured, we can approximate its former properties. This is, in effect, what you do when you comply with Rule 23 in the welding of coupler bodies, coupler yokes and truck sides or any Grade B cast-steel part.

Many of the typical welding jobs on the repair track concern steel shapes and plates such as center sills, side sheets, post angles, etc. Rule 22 defines the sequence under which welds are to be made but it does not define a detailed procedure which tends to control warpage and other elements which assist in making a sound finished weld joint.

(Mr. Gannett then explained the following weld procedures: Multiple-pass, back-step, intermittent- and single-pass welds, heavy beads vs. small beads, in their relation to warpage, arc blow and magnetic control, why welded and riveted composites are not cumulative in strength, malleable-iron surfaces and bronze welding, cast-iron surfaces and welding, or bronze-welding, and cutting abuses.—Editor.)

Burlington Converts Government Kitchen Cars

Some months ago, the Chicago, Burlington & Quincy purchased from the War Assets Administration 300 surplus government kitchen cars and is now rapidly completing the conversion of these cars for baggage-mail-express service at the company shops, Havelock, Neb. The cars will replace 300 box cars equipped for head-end passenger-train service, the box cars then being available for general freight service where they are badly needed.

The converted kitchen cars are in reality better fitted for passenger-train service than the special box cars formerly used, because they are equipped with buffers and passenger draft gears. The AB-1-B brakes and steam trainlines are also part of the original equipment. Each car has two brake valves and two cylinders, each operating the brakes on one truck.

In preparing the kitchen cars for the new service no major change in design is required. The cars are simply stripped of kitchen equipment, water tanks and piping, fire extinguishers, emergency tools, etc., leaving the lights and steam heat in the cars. The cars are lighted by special 6-volt lamps with electricity supplied from Eveready R 2600 air-cell batteries.

Openings in the roof are closed; crosswise steam coils relocated; windows protected by cross bars; stanchions applied to guard the sliding side doors; interior floor and lining repaired; interior painted with aluminum; exterior painted, relettered and renumbered; air brakes cleaned; journal boxes repacked; and Allied trucks repaired.

A placard holder is placed near the end of each car at about the same height as on other C. B. & Q. baggage cars. Hasps are applied to side doors to accommodate postal locks.

Interior of the kitchen car after conversion for handling baggage, mail, or express

Load Compensating Brake

(*Continued from page 692*)

Fig. 5 is a piping diagram of the complete load compensating brake equipment. It shows the relation of the various parts to each other and to the standard AB brake equipment. The shaded parts are those added to the AB equipment to provide the load compensating brake.

The valve dotted in, in the brake cylinder line, is a brake cylinder release valve. Its function is to vent the brake cylinder pressure when cars are to be shunted, and to do this without loss of the reservoir pressures. This valve is manually opened by a trainman after the brake pipe pressure has been vented. It will then remain open until brake pipe pressure has been restored, when it automatically is restored to normal position.

The A. A. R. has authorized the installation of a limited number of the load compensating equipment and also of the release valves. When a sufficient number of cars have been equipped with the former, they plan to conduct road tests of 150-car trains under the empty and loaded conditions. Observations will be made both as to general brake performance and as to stopping distances from various speeds in comparison with the same performance with the present single capacity brake.

One of 300 government kitchen cars converted for baggage-mail-express service on the C. B. & Q.

EDITORIALS

Freight Claims And The Car Man

The work of railway men in several different departments has an important bearing on the large amount of money which is paid annually to shippers in claims for damaged freight shipments, but car men have primary responsibility, for on them devolves the critical job of (1) maintaining car equipment, (2) selecting and carding cars for commodities they are suitable to carry and (3) inspecting cars at interchange points and making light or running repairs in such a way that loaded commodities will reach their destination safely and with minimum delay.

The magnitude of the responsibility which car men bear in fulfilling this duty is indicated by the fact that current loss-and-damage claims are costing the railroads in excess of $100 million annually. Records of the A. A. R. Freight Claim Division show that over 5½ million individual claims were filed against the railroads during last year, or the largest number ever filed in a single twelve-month period.

The contribution which car-department men can make was recently summarized by the A. A. R. Freight Claims Division which maintains that car men, as builders, are naturally prevention minded and if they can unite their knowledge of equipment with claim men's knowledge of damage causes, a substantial reduction of loss and damage will result. It cannot be emphasized too strongly that car men need to study the nature of car defects which cause damage and take effective steps to correct them. Otherwise the damage will be repeated each time the car is used. This applies particularly to any kind of projection inside the car, including nails or bolts.

Other suggestions are that car men (1) help show railroad and shipper representatives what they can do to keep equipment clean and prevent abuse of cars which destroys their usefulness for subsequent first-class loading; (2) keep posted on commodities most susceptible to damage in certain classes of cars and impart this knowledge especially to yard men or others who have to select cars at points where experienced car inspectors are not available; (3) be sure to remove old classification cards each time a car is loaded or selected for loading; (4) use special care in cleaning cars whenever there are indications of previous loading with soda ash or other contaminating commodity which may work out from lining or floor cracks and damage grain or food products in later loads.

Intermediate inspection points can assist by stopping and correcting defective loads which originate at smaller points and promptly advising those responsible of all failures and how to avoid them. In fact, there is urgent need for better means of enabling car men at outlying points to benefit from the wider experience gained at principal interchange centers.

Car men need to be diligent in helping shippers and agents load machinery and other difficult items, also in maintaining running gear so as to avoid transportation failures and encouraging yard men to handle cars carefully and well within the limits of modern draft-gear protection. Still another thing which needs to be watched is the passing of cars with illegible numbers which result in delays and mishandling.

For Better Welding

Welding and the allied operations play leading parts in all phases of shop and enginehouse work. Because they do it is important that the mechanical departments keep abreast of new developments in the field outside the industry which can be given railroad applications and be informed of improved techniques and practices within the industry.

One way to strengthen the railroads' welding position would be to place welding under the guidance of top-notch welding engineers and supervisors. There are so many ramifications of welding and the associated operations that these men must be specialists. Optimum performances can not be expected of men saddled with that work in addition to other duties. For one thing welding engineers are needed to design parts for welding if maximum strength and economies are to be obtained. They are needed to select the right combination from the multitude of processes, electrodes or welding rods and welding equipments for the material to be welded. They are needed to train the welding operators who play such an important part in the quality of the finished product.

Another step that could be taken to improve railroad welding would be to have their engineers and supervisors participate more actively and in greater numbers in the meetings of the American Welding Society. The mechanical departments benefit by participation in other organizations which have the presentation of new developments and the interchange of ideas as paramount objectives. The A.W.S. is the logical place to find out about progress in the welding field and to discuss problems of mutual interest. This society is organized as well to conduct research in any phase of welding. The attendance at the railroad session during the recent annual meeting of the society in Chicago indicates that most railroads are not taking advantage of the opportunities for enlightenment afforded by these meetings.

The mechanical departments could very profitably schedule symposiums on any one of a number of subjects at these meetings. Arc welding, oxyacetylene welding, shape cutting and flame hardening in railroad shops are suggested topics. At the recent annual

meeting of the Master Boiler Makers' Association there was considerable difference of opinion expressed about the welding of alloy steel boilers. The best place to discuss this subject would seem to be an A.W.S. meeting. The control of distortion in welded passenger and freight car sides due to welding stresses would be another topic of considerable interest.

The four top winners in the railroad classification of the $200,000 Design-For-Progress Program of The James F. Lincoln Arc Welding Foundation, announced elsewhere in this issue, are all engineers from the railroad supply industry. It is therefore not surprising that some of the outstanding welding set-ups in the country can be found in the plants of the car and locomotive builders. Men who know welding and keep in touch with developments are an indispensable factor in getting the most out of welding.

Train Communication

Thirteen railroads replied to a recent A.A.R. request for information covering their use of train communication. The request was made by the Committee on Radio and Allied Communications As Applied to Railroad Operation of the Communications Section, A.A.R., and a summary of the replies was published in a supplement to the 1947 proceedings. The reports were relatively incomplete since a considerable number of the installations were made so recently that sufficient data for preparation of estimates were not available. Under the circumstances, the committee did not feel warranted in drawing any conclusion.

The report is nevertheless interesting, and its very incompleteness, coupled with known facts, serves to describe the present situation. For example, the 13 railroads reporting show a total of 399 locomotives and 171 cabooses equipped for main-line service, and 196 locomotives equipped for terminal service. This is out of a total of 42,841 locomotives and 24,106 cabooses, operated by Class I railroads. The apparently small number of installations has given some concern lest the railroads be criticized for making insufficient use of radio channels assigned to them. A major part of the systems reported by the 13 roads employ inductive communication, but there is obvious need for radio as well as inductive systems.

There are a number of reasons for the situation. Railroads must adopt entirely new things slowly and carefully, and the use of such a communication system involves a strong need for standardization. Equipment must be sufficiently rugged to withstand the vibration, shock and dirt common to operation on cabooses and locomotives. It must be capable of staying in service without attention for long periods of time. The railroads must also establish adequate maintenance and servicing facilities. Up to the present time, suitable equipment has not been available in quantity.

Most of the installations reported by the 13 railroads use axle-generator power supply on their cabooses. It is apparently working well, but it involves a number of unsolved problems of yard battery charging and equipment servicing and maintenance. Several roads are trying engine-driven generators for caboose power supply, but only one of the 13 reports on their use. It has been determined recently that voltage regulation must be close if tubes in sending and receiving sets are to have the life, and give the dependable service, that should be expected of them.

Some railroads are working to develop new things such as gear drives for small axle generators, inductor type, a.c. generators, etc. Others are seemingly just waiting to see what the more aggressive operators produce. All railroads are much concerned about what may be expected in power for caboose lighting and other applications, but if they refrain from doing anything because of this, or because they wish someone else to do the development work, they would deserve to lose the many advantages of their present position. A few railroads and manufacturers are doing some first class engineering development work and they should be given help and encouragement by everyone who expects to profit by the development of train communication. Its potentialities are too great to risk early misdirection or loss of position in the radio spectrum.

Future Railway Fuels

As the rate at which Diesel locomotives are going into service has accelerated, evidences of concern are appearing on the railroads as to the extent to which Diesel fuel will be available in the future. The immediate prospect of a short supply of petroleum products during the coming winter, particularly in the middle west, has, no doubt, been a factor in stimulating this concern.

The shortage in immediate prospect, however, is temporary in character. Among its causes are a shortage of pipeline capacity upon which the interior of the United States depends for the transportation of much of its petroleum and petroleum products and a shortage of refinery capacity. The effect of these factors has been aggravated by the rapid increase in demand for certain petroleum products caused by the growth of the house-heating market, by transfers from coal to oil because of the uncertainty as to the availability of an adequate supply of coal and by the increase of Diesel fuel consumption on the railroads.

But, temporary as these conditions are, there is need to look at the factors which will determine the availability of petroleum products for the more distant future. These have been studied by the Bureau of Transport Economics and Statistics of the Interstate Commerce Commission and the results published in "Postwar Levels of Demand for Transportation Fuels Compared with Reserves." Estimates of the fuel demands of the various transportation agencies were made for the years 1947 and 1948. Fuel reserves were appraised, some attention was given to competitive forces affecting the use of various sources of energy,

and the factors affecting the future trends of fuel prices were discussed.

The Bureau finds that the North American continent "is using and probably will continue to use its petroleum resources at a higher rate when compared with reserves than any other continent having significant production." To recover oil from a pool at too high a rate has proved wasteful. Such withdrawal results in the infiltration of water before an adequate proportion of the oil is removed and too high a percentage of the latter cannot be recovered. According to the American Petroleum Institute the proved reserves of petroleum in the United States (those which have been explored by drilling) amounted to 20.45 billion barrels in 1945 and the production of petroleum to 1.74 billion barrels. This is a proved reserve equal to only about 12 years' production. A rate of removal calling for a reserve equal to 20 years' production is considered desirable in many fields.

The I.C.C. study shows that the amount of drilling required to produce a given quantity of petroleum is increasing, indicating a steadily increasing cost of replacement of proved reserves. This and high corporation taxation are brakes on the incentive to undertake the financially hazardous operations of exploring new fields.

The I.C.C. also finds that the United States has become a net importer of petroleum and estimates that foreign petroleum production will fall behind the foreign demand by 1951. It expects a probable continued moderate increase in price "relative to the movement of all wholesale prices" up to 1965, assuming no change in the tariff.

Coal reserves, which at the consumption level of 1943 will last for over 5,000 years, are already being developed as sources of synthetic petroleum products. And there are large reserves of natural gas and shale oil which can be synthesized into gasoline and natural gas. If the supply of petroleum continues to decline in relation to the demand and prices continue to rise, the product of the synthetic processes will come into the market to supplement and compete with the products of natural petroleum. Indeed, the synthetic processes are already in pilot operation.

It would be presumptuous to attempt a prediction as to the full effect of all these forces upon the future use of fuels and of the types of motive power to burn them on the railroads. At the present time a large part of the liquid fuel used by the railroads is burned in steam locomotives. This is an end product of distillation and for many years it cost the railroads but a few cents per barrel. Today, because modern distillation processes permit the conversion of a high percentage of petroleum into gasoline, Diesel fuel, and furnace oils, the price of the end product is going up. This may improve the prospects of the Diesel. Indeed, if all oil-burning steam locomotives were replaced by Diesels, the overall quantity of liquid fuel required, because of the high thermal efficiency of the latter, would be considerably reduced.

Another uncertain factor in the situation is the pulverized coal-burning gas-turbine. How this may affect the situation may be known within the next four or five years.

Induced-Draft Fan

With an annual coal bill approaching 400 million dollars—no negligible part of which is due to the fact that frequently as much as 20 per cent or more of the total steam locomotive horsepower is required to produce the draft—continued complacency in neglecting possible means of increasing efficiency is open to question. In the matter of producing the draft for the effective combustion of coal there has been no change in basic design since virtually the first crude locomotives. Draft is still produced by a simple but highly inefficient exhaust nozzle dragging air for combustion through holes in the grates with the accompanying heavy drain on locomotive horsepower output. Substantial aid to combustion is given by two comparatively new developments—overfire air jets and the undergrate air distributor—the use of which seems desirable with the present drafting arrangement as well as with any improved drafting design. But the fundamental design of the locomotive drafting system has yet to be changed so as to provide sufficient quantities of air for good combustion while itself requiring an appreciably lower power consumption than is common for the exhaust nozzle.

Any arrangement that offers hope for supplying the combustion air at an appreciably lower power consumption is worth at least a preliminary investigation. This includes the induced-draft fan, despite a complete lack of success in past installations. Perhaps modern developments in fan design and metallurgy will make success possible where only failure was found before. Higher fan speeds and the better blade design of the present time may be the answer to the lack of capacity so often found in previous experiments. Metals that are available today are far more abrasive resistant than those available 20 and more years ago. If an investigation showed a test installation to be justified, the first could be made on an oil-burning locomotive to avoid too many problems to solve at one time.

On the positive side the induced draft fan offers many advantages if it can be developed into a reliable appurtenance. A reduction could be obtained in the power demand on the locomotive for drafting the fire; the draft would be more uniform, particularly at low speed; it would be independent of the cylinder back pressure and would be under the direct control of the fireman; cylinder performance would be improved by exhausting directly to the atmosphere. The greater combustion efficiency would reduce fuel costs and would improve operation by making more horsepower available at the drawbar. Ashes, the disposal of which is always a problem, would be reduced to the extent that the locomotive efficiency is increased and proportionately less coal has to be burned.

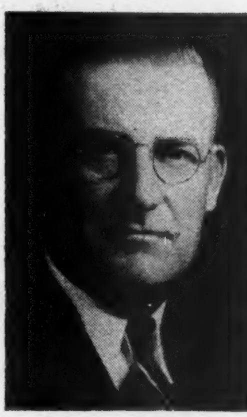
With the Car Foremen and Inspectors

Car Lubrication Practices*

Shop and servicing methods and tools to produce quality work are essential factors

Your committee last year suggested some changes in the then recommended practices in connection with materials used in lubricating journals and we quote in part from the A. A. R. Report of Committee on Lubrication of Cars and Locomotives, dated May 23, 1947:

"Following up this statement, it was suggested that your committee make a comprehensive study of the A. A. R. standards and, if possible, develop specifications for the best grade of waste and oil for journal box packing and recommend that these revised specifications be made mandatory through the A. A. R. rules to bring about the desired results in service to reduce hot box delays and damage to equipment to a minimum.



K. H. Carpenter, Chairman

"The question of possible improvement in the present A. A. R. specifications covering waste for journal box packing and the desirability of, or necessity for a more restrictive specification to be universally required for packing boxes on cars in interchange service under the A. A. R. rule was discussed at length at the meeting of the Committee held in Altoona, Pa. on March 6, 1947. The question of possible revision of the present A. A. R. specifications for car oil to improve its lubricating qualities under extreme weather conditions was also discussed. It was the consensus that your committee should not recommend changes in the A. A. R. specifications for waste and oil leading to the objectives suggested by the C. D. O. A. Committee on Car Lubrication Practices without a factual basis as to what constitutes the best grade and mixture of waste service for all season service and the characteristics of the oil for use with the waste determined or accepted as the best grade, mixture, and preparation for journal box packing. This factual basis could probably best be arrived at through laboratory tests, followed up by service tests designed to evaluate the physical characteristics and oil storage and feeding qualities of the waste and the lubricating value of the oil. It was decided to make a further study of the problem attending the setting up of a research program to develop the essential facts in this involved problem and, if justified, request an appropriation from the association to cover a preliminary laboratory program to be carried out under the Mechanical Division Research Office on the testing machine available either at Altoona, Pa. or Indianapolis, Ind."

Whatever action is taken by the A. A. R. committee to improve the specification for oil and waste, will improve hot box performance.

To control hot boxes, proper compliance must start in the wheel shop and end in the service treatment of journals in train yards.

So many operations are dependent on others in relation to good lubrication practices and performance that nothing can be overlooked if satisfactory performance is to be obtained.

As we stated last year, strict compliance with rules of the Wheel and Axle Manual will produce highly satisfactory journals and we can then reasonably expect satisfactory results if other suggested methods, rules, instructions, etc., are practiced in regard to truck maintenance and lubrication. However, many railroads overlook the necessity of proper wheel shop practices which defeats practically any kind of lubrication program.

Tolerances have been progressively restricted in later years due to heavier journal loads and increased speeds, but in many cases wheel shops are operating with antiquated machines which cannot produce proper workmanship or the minimum requirements of the Wheel and Axle Manual. In many wheel shops the personnel is badly in need of instructions and qualifying ability to turn out acceptable work; there is too much emphasis placed on quantity and not enough on quality.

When wheels and axles are properly machined and mounted, our basic lubrication foundation is obtained and if truck maintenance is proper the car journal should give many miles of satisfactory service without heating.

To lubricate journals properly they must be thoroughly cleaned before application. All roads use some kind of rust preventative which must be removed before wheels are applied. Probably the most accepted manner of removal is by cutting the coating loose with kerosene and then wiping the journal with waste, rags, or wiping towels. The best journal produced will start out under a handicap unless all of this coating is removed from the journal, end of collar, and dust guard fit. It is essential that all the kerosene be removed so that the journal will receive maximum lubrication at once.

The accepted methods as outlined in the Wheel and Axle Manual and the requirements of Rule 66 relative to wheel application and packing of journal boxes will produce desirable results insofar as lubrication is concerned. However, these requirements cannot be obtained unless the proper tools, facilities and materials are available.

There should be no necessity to repeat the Manual's instructions or rules in this report, but we venture to say that if all car department supervisors would read their manual from cover to cover each year, they would be amazed at the numerous conditions

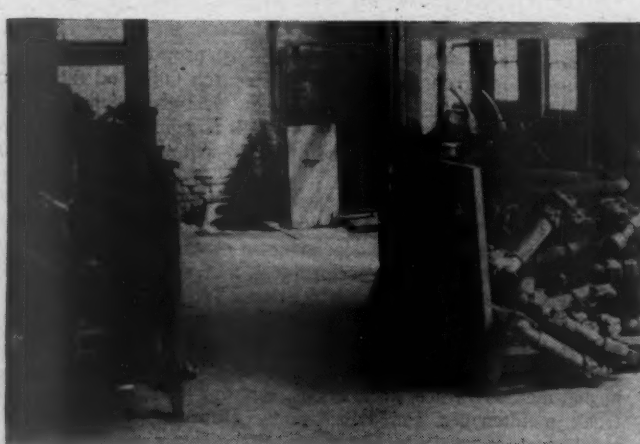
(*Continued on page 702*)

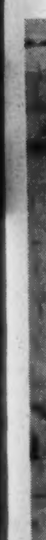
* From a report of the Committee on Car Lubrication Practices presented before the meeting of the Car Department Officers' Association at Chicago in September, 1947.

Above: The main dismantling and assembly bench for Vapor connectors—Foot-operated clamps hold the connectors securely—The revolving tray holds springs, bolts, and other small parts needed in the assembly

Metallic Stean C
Repairs on C

A SPECIAL department has been equipped at its Chicago shops by the Chicago & North Western for reconditioning flexible metallic steam-heat connectors. Labor-saving jigs and standard tools and wear gauges are provided in a space 30 ft. by 40 ft. in a car shop building for overhauling connectors from the entire system once a year. Two repair men handle the work in batches of 50 to 60 connectors at a time. A later article will give details of gauges, tools, and repair methods.





Above, left: Connectors i stock bins awaiting repair

Above, right: Large welde metal tray with 19 compart- ments of various sizes i which bulky parts of connec- tors are moved to the assem- bly bench—This is 5 ft. b 3 ft. by 15 in. deep—Th material rack in the back ground is 30 ft. long a 5 ft. high — In it a stored new connector pa

Left: Left to right, sho made air press for apply ing bushings; drill pres portable metal trays (24 i by 36 in.) at bench level f reclaimed parts—Behind t drill is a grinder and buff

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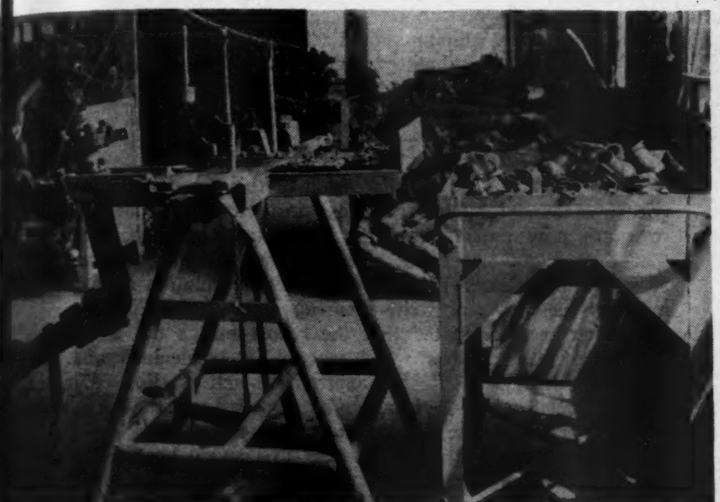
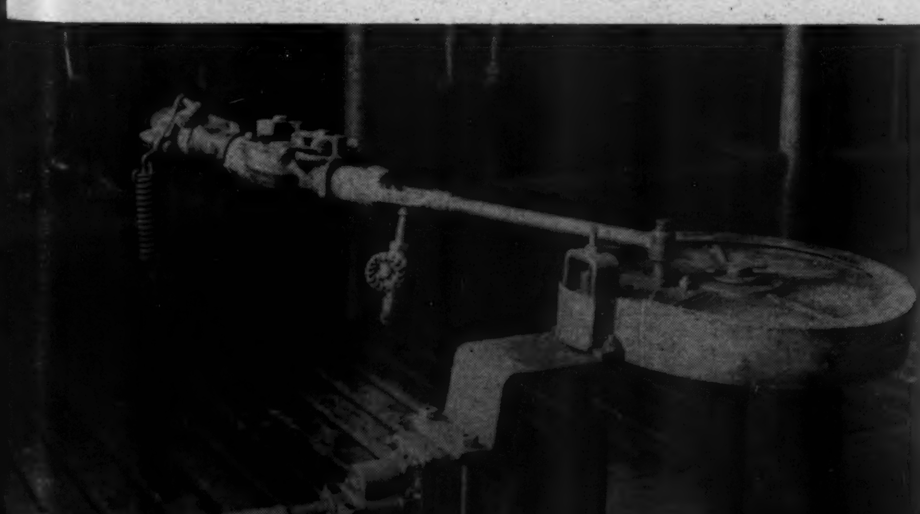


Left: Jig for dismantling and reassembling Barco FT-1 connectors—The near end is for dismantling; the far end for assembling—The pedal compresses the assembly to simplify bolting

Above left: This jig is for dismantling and assembling Vapor 1196 and Barco FT-2 connectors for 2½-in. trainlines—It is made of ½-in. plate and is supported on 4-in. pipe stands—The long tool which is leaning against the stand is used for clamping the connector when removing and reapplying the bolts

Above right: For applying coupler heads to Y-castings (Vapor), horizontal tubes (Barco), and rubber steam hose—One head is bolted to the stand and the other head is coupled to it—The tube or hose is then removed and reapplied with a pipe wrench

Above: Test bench for connectors, No. 244 valves, regulators and end valves—Below left: The connector, rigidly supported from the bench, receives steam at about 150 lb. per sq. in. at its upper end and is coupled to a dummy at the lower end—This is driven by pitman from the device in the foreground—Three minutes is normal break-in time—Below right: Overhauled connectors racked ready for spray painting—Ten connectors are supported on each side 8 in. on centers—Tags show date of repair



Car Lubrication

(*Continued from page 699*)

in their wheel shop and wheel handling practices that could stand correction.

To provide good work in train yards each oiler must be furnished a packing iron of sufficient length and strength to set the packing at the extreme rear of at least 11-in. boxes, and a good packing iron is of little value unless the oiler actually knows what he is doing and sets the packing to the desired height. He must also be furnished a small, sharp, pointed hook of proper length for use in detecting waste strands under journal bearings. If he is on the night shift he should have the best light obtainable, not the poorest, as is generally the case. In addition, well designed oil cans and waste pails should be furnished.

We must place the materials he is to use at strategic places in the train yard so that he can get to them without climbing through or over cars, or having to walk needless additional steps around cars. In addition, these materials must be properly stored; bearings must be stacked so they will remain in good condition; packing must be under cover or in weather-tight drums with weather-tight heads. In cold weather, both packing and oil must be kept in heated buildings.

We called your attention to educating oilers in our report last year and we want to again stress this important matter. You will get no more out of your oiler than you insist he give you, and if you will accept a mediocre job, you will get no better.

Truck Repairs—Side Bearing Clearance

Many hot boxes could be eliminated with better workmanship and truck maintenance in shops and repair tracks. Rule 66 provides for the proper inspection and application of packing. If the instructions in this rule are followed diligently, the basic application of materials is at least correct and if the railroad has packing, bearings and oil of good quality and the journals, wheels, trucks, etc., are in good condition, hot boxes will be greatly minimized. This means that loaded cars must have sufficient body and truck side bearing clearance, wheels must not be out of round, brake burn comby, or with worn flanges. Side frames, truck bolsters, journal boxes, center plates, truck springs and spring planks must all be in good condition, as all reflect directly or indirectly in journal heating.

Last year we told you about the poorer quality of materials we were having to work with and we want to emphasize again that there is still no improvement; yet we are increasing train speeds, journal loads, lengths and heights of cars, all of which have a direct bearing on hot box performance.

Many roads are using Diesel locomotives which operate at high sustained speeds for long periods, sometimes running entire divisions without stops. This means higher journal temperatures due to increased friction and only better oil and other products will dissipate this additional heat. We cannot keep on increasing journal load and speed without better bearings, oil, packing, etc., if we are to keep down hot boxes.

We are applying so-called high speed trucks under new freight equipment capable of speeds up to 85 m.p.h. and to accomplish this the truck manufacturer designed an entirely new spring principle, but we have the same old journal box assembly with the same old packing, oil and bearings.

From 40 m.p.h. to 60 m.p.h., journal friction increases over 100 per cent, end thrust friction increases over 200 per cent, wheels turn at about six hundred r.p.m. at 60 m.p.h., so it is evident we must have good materials to withstand the increased friction caused by these higher speeds.

Tolerances have been progressively restricted in wheel shops on journals to provide better materials, but journal wear tolerances have been increased, as has also train speed. It would seem that as speeds increase, wear tolerances should be more closely restricted. We cannot expect to get better hot box mileage when we place a greater load on lubrication by increasing both speed and wear tolerances.

The friction bearing is going to be here a long time and we should improve it and the journal box assembly, so as to get the advantage of more desirable performance.

Packing retainers have been improved and although they are not a cure-all, we believe there is a distinct advantage in their use, controlling the movement of packing in the box. The cost of application is so small that the decrease in hot boxes caused by waste grabs should be a real incentive for most railroads to use them under all freight and passenger equipment; also service treating boxes equipped with retainers takes less labor as the packing needs less adjustment.

One large packing service company states if good lubrication is to be obtained and maintained, four cardinal rules must be universally adopted: namely, an enforceable specification for new oil and waste that assures quality lubricants; a specification for renovated material that approximates the new material specifications; uniform weight-volume of packing per box which will unquestionably make necessary the use of machine-made waste pads or rolls to replace one piece packing; tight closures to assure and maintain the maximum advantage of quality lubricants.

(The report was submitted for the committee by K. H. Carpenter, chairman, superintendent car department, D. L. & W.)

Discussion

There was an extensive discussion of this report which began with a statement by one chief car inspector that more freight cars are now passing through interchange in such condition that they ought not to be operated than he has observed in 50 years' experience. He said that the only solution is to retire many of these cars or write them up under Rule 120.

Another member stated that the report brings out a number of mechancal conditions which should be condemned and referred to the A. A. R. for appropriate action. For example, he mentioned wheels, also coupler crosskeys and truck side bearings, as the cause of numerous failures.

Another suggestion advanced was to provide heavier flanges on body center plates. In connection with side bearings, this member said that the possibility of making them adjustable should be fully explored, as this improvement would save the railroads large amounts of money annually.

B. H. Barrett, general shop superintendent, C. B. & Q., Havelock, Neb., confirmed the report that center plates are weak, but said they are not entirely at fault as the car bodies are still required to take excessive shocks due to inadequate draft gears. He indicated that body bolsters also are suffering from this condition. Mr. Barrett commended the present Z-bar center sill construction, but urged the use of full-size center fillers which may be welded in place. He said that designers are now sometimes going too far in attempting to save weight at critical points in the car construction.

P. J. Hogan, supervisor car inspection and maintenance, New Haven, suggested that freight car trucks be stenciled for greater ease in getting trucks reassembled under the proper cars in cases of derailment.

Freight Car Developments*

***By J. A. Welsch*†**

Freight equipment on the railroad is the revenue producer, and the maintenance of freight equipment and the claims paid to shippers, for damage to ladings, have a pronounced effect on earnings.

Many new developments are occurring in the freight-car field. For example, the Association of American Railroads is making extensive tests of various new types of brake beams which manufacturers have presented to them, and there is no question in my mind that a greatly improved beam will result.

Freight claims are rapidly increasing which is shown by the startling payments made by U. S. railroads as follows: $59,756,000 in 1944; $78,791,000 in 1945; $94,300,000 in 1946. Thus far, in the current year, freight claims paid are running 20 per cent over 1946 so that the total payments for 1947 will be over $110,-000,000. This year will be the first year since World

* Part of a paper presented at the November 10 meeting of the Car Foremen's Association of Chicago.
† Superintendent, car department, Illinois Central.

War I that they have exceeded $100,000,000. Is it any wonder, therefore, that all railroad managements are vitally interested in this subject, not only because of the millions which they pay out in claims, but because claims mean dissatisfied shippers and loss of traffic.

For many years it was felt that little could be done by the car department in the reduction of freight claims as it was the impression that most of this was due to rough handling of equipment. This may have been a defeatist attitude, for recent investigations make it appear that rough riding of freight cars is unquestionably responsible for a larger percentage of damage claims than rough handling. It is for this reason that easier-riding freight-car trucks which have been developed and are now available for new equipment and improved spring and spring-damping arrangements for existing cars, have received and should receive greater consideration by car departments. In addition to this, easier-riding trucks should be of direct interest to the car department as they will probably substantially reduce maintenance of both equipment and road bed.

Cars Delayed at Interchange Points

It is a known fact that cars are delayed entirely too long at interchange gateways and in many cases are inspected three or four times before leaving the terminal. New and more efficient methods will have to be developed in the inspection and handling of cars at interchange points. Since this inspection is usually between two or more roads, it will require coordination. It is necessary for us to devise ways and means, so far as we in the car department can, to help insure faster and better service at less cost in order to meet future competition.

Good results have been obtained in better inspection where the car foreman applies enough personal effort to educate his yard forces to insure that cars are bad ordered only when necessary. Closer inspection must be made of cars at originating points on the line to see that the car and lading are in condition to go through to destination. This will expedite the handling of trains both on the line and at terminals.

Much thought must also be given to better inspection, classification carding, and repairing of empty freight cars before they are placed for loading. Generally, the loaded car receives the preferred inspection, whereas it is just as important to inspect the empty car, make any repairs necessary and then card it for the commodity it is suitable to carry. Many delays to loads and the possibility of transfers or adjustments of lading with freight claims resulting from this source may be avoided if the inspector is properly educated and alert in the performance of his duties.

More Effective Handling of Bad-Order Cars

We must also think up more efficient methods of handling bad-order cars. When a car is on the repair track for some particular defect, it should be thoroughly inspected by a competent inspector or foreman and all repairs made as required by the interchange rules. This will avoid stopping the car at some other repair track a few days later. Consideration must also be given to the so-called "high-speed repair tracks" where bad order loaded cars must be placed, repaired and forwarded in their regular scheduled trains.

From a classified or heavy-repair standpoint, our program on the Illinois Central is to get all freight cars through the shop on a four-year cycle. This is done most economically by selecting certain series of cars and assigning them to a certain shop where the schedule is set up to repair a specified number of cars per day. AB brake applications are made to cars going through the shop on these programs. It is necessary to follow up with the transportation department to get the cars into the shop and with the stores and purchasing departments for the necessary materials. We have succeeded in this program to the extent that we believe our freight cars are in as good physical condition as any in the country at this time.

In 1935 the Illinois Central started experimenting with the conversion of some cars and building others for pulpwood, stone and other special commodities. At that time, one particular car was built which I want to call to your attention. It was an all-steel, wood-lined box car, built in accordance with A. A. R. specifications in effect at that time. The car has not been in the shop for other than painting, cleaning of brakes, etc., since it was built, and we call it the "granddaddy" of our present day equipment. It is to be used in comparison as to serviceability with cars we have built or purchased since that time and what is known as the package car.

I. C. Builds 600 Composite Hopper Cars

In 1943 we were in dire need of hopper cars which could not be obtained from any manufacturer, and we set out to build 600 A. A. R. composite hoppers in our own shop. Some of the fabricating work was contracted to manufacturers, some was performed in our locomotive shop at Paducah, and some of it was done at our Centralia Car Shop, where the building took place. Since that time we have installed fabricating machinery, presses, etc., for car work at Centralia and have built completely 1,500 box cars, 350 auto cars, 500 flat cars and 450 hopper cars, or a total of 2,800 cars. This operation has proved entirely successful as well as economical.

At this time we are having constructed by one manufacturer, 400 hopper cars of Cor-ten steel. This will be an all-welded job. The light weight of this car is estimated at 34,000 lb., and since this is a 50-ton car, the braking ratio requires the car to be equipped with load-compensating brake.

We also are constructing five hopper cars of aluminum in our shops at McComb, Miss. This operation requires heat treatment of the aluminum materials after parts are fabricated.

We expect to use nailable steel flooring for experimental purposes in some of our mill-type cars to be built in 1948. It is supposed to save costs because of longer wear and less liability to damage from impact loading or ripping with unloading tools. It is claimed that under normal conditions this floor will last as long as the car itself, but of course we in the field know that it will be subjected to all conditions except normal.

An Innovation in Dust Guards

Much could be said about hot boxes, but I merely want to bring out here the development of a dust guard which is an innovation in design and material, employing a 16-gauge hot-rolled steel insert for added strength and resistance to strain and graphite-coated rubber to seal in the oil and seal out the dirt or other foreign matter. This dust guard has four rubber bands extending around its outer edges at the back and front of the unit. This synthetic rubber material, which is oil, heat and abrasion resistant, is chemically and mechanically bonded to the steel insert, so no pull or roll of the axle can displace it. As the dust guard moves horizontally or vertically in the dust guard well, the rubber acts as a squeegee, preventing entry of dirt, dust, etc., and seals the oil in. Wheels may be changed without damage to the dust guard.

Shipper demand for high-speed livestock service has prompted the Union Pacific to equip 800 stock cars with

roller bearings. Cars so equipped have resulted in increased business. This is a barometer for those of us handling livestock, and we should be looking into it.

The treating of lumber used in building and repairing stock cars is another development attributable to the car department.

Last, but not least, is the experimental aluminum refrigerator car built in the I. C. shop at McComb, Miss. This car was built to plans formulated by the Refrigerator Car Committee of the United Fresh Fruit and Vegetable Association. It has many innovations. It has been on display at Chicago, New York, Washington and other cities and is still under surveilance of the United Fresh Fruit and Vegetable Association as well as engineers of the Association of American Railroads. From all reports its performance has been good. The car has collapsible aluminum bulkheads and has successfully handled merchandise on its return trips to the fruit territories.

Pullman-Standard Employee Suggestions

The employee suggestion system, developed and extensively used at the Pullman-Standard Car Manufacturing Company shops at Bessemer, Ala., Butler, Pa., Michigan City, Ind., Pullman, Chicago, and Worcester, Mass., is producing hundreds of suggestions which in the aggregate greatly promote increased car shop safety, efficiency and output. Specific objections sought with this suggestion system include reduction in costs, improvements in production, quality, or designs, better public relations, safer operation, better plant housekeeping and working conditions, elimination of waste, and reduced weight of equipment.

All suggestions are received, analyzed and rated on an individual plant basis. Those accepted are recognized as the basis of cash prizes of varying amount awarded to the employees responsible. As reported in the November, 1947, Supplement to Pullman-Standard's monthly publication "The Car Builder," there were a total of 203 individual suggestions submitted at the company's five plants.

Device for carrying Insulmat drum and spray machine

Method of applying cheese cloth backing to shellaced stencil paper

Typical of these suggestions is the device for carrying an Insulmat drum and spraying equipment, both at the same time, from one car position to the other with the shop crane. This device is used at the Worcester passenger-car shop.

In the illustration, it will be observed that two steel bands encircle the drum and are welded to a pair of ⅜-in. by 3-in. vertical steel bars which are united at the top and forged into a hook shape for engagement with a chain from the shop crane. The circular bands are hinged on one side and pinned on the other for ease of placing around the drum which they fit snugly just under the upper rim and the lower stiffening corrugation. This prevents the drum from slipping out of the device when an upward pull is exerted on the hook.

The device also has an upward projecting arm or bracket which forms a convenient support for the large Insulmat hose, smaller air hose and spray gun used in applying the material to car bodies by the spray method. The advantage of this device is that it keeps the drum and all equipment used in spraying Insulmat all on one carrier which can be easily handled about the shop with a single crane movement, whereas at least two crane moves were formerly required.

Another suggestion, advanced by an employee at the Bessemer freight-car shop, consists of backing up shellaced stencil paper with cheese cloth to give greater strength and durability to the paper, hence increasing the life of stencils and enabling cleaner work to be done with them. In the second illustration, a large sheet of stencil paper is shown on the shop floor with a girl applying a coat of shellac to the paper after which the cheese cloth is unrolled and firmly adheres to the shellaced surface of the paper which is then cut into stencils by the usual methods. It is estimated that the resultant increased stencil life at this shop effects a saving of about $300 a year.

Flue and Tube Application and Maintenance

A committee report presented at the annual meeting of the Master Boiler Makers' Association on September 18, 1947, discussed the application and maintenance of flues and tubes. Each of the committee members contributed papers describing the methods practiced on their respective railroads.

The committee was composed of E. H. Gilley (chairman), general boiler foreman, Grand Trunk; E. E. Owens (vice chairman), general boiler inspector, Union Pacific; S. F. Wentz, stationary boiler inspector, New York Central; F. E. Goodwin, district mechanical inspector, Canadian National; L. D. Prior, regional boiler inspector, Baltimore & Ohio; A. T. Hunter, assistant general boiler inspector, Atchison, Topeka & Santa Fe; A. D. O'Neal, chief boiler inspector, Pere Marquette, and J. J. Desmond, boiler foreman, Washington Terminal.

An abstract of the paper presented by Mr. Owens follows. The papers prepared by the other committee members will be published in abstract form in later issues.

All flues and tubes have the beads seal welded in the firebox ends when applied to locomotives on our system. In removing them when new flue sheets are not required, it is our practice to burn off all beads with the cutting torch at the firebox end. Flues 3½ in. and larger are then burned off just inside the front flue sheet with the acetylene cutting torch. All 2-in. and 2¼-in. tubes are cut off just inside the front flue sheet with standard cutting-off tools. One or two of the large flue holes are rolled out and all flues and tubes are removed from the boiler through these enlarged holes.

When necessary to renew arch tubes, the old tubes are removed by burning off flush at the fire side of the door and flue sheets, and the remaining burrs removed from the holes by splitting them with a cutting torch, collapsing the burr with an air hammer and oyster knife tool.

Safe-Ending of Flues and Tubes

The drum type rattler is used for cleaning flues and tubes. After cleaning and inspection the flues and tubes are cut off square at the end to which the safe end is to be welded. The machine used in cutting off the flues and tubes at this station is a disk cutting knife revolved by electric motor, the cutting disk and shaft being stationary, the flue or tube being forced up to the cutting disk by a small hydraulic jack operated by means of a foot lever. While the flue is revolving during the cutting-off operation, its end is being polished with an emery stone which is held on the flue or tube by a lever arrangement operated by hand.

The flues and tubes are then rolled to an electric resistance welder that operates automatically. The tremendous force exerted in bringing the flue and safe end together during the welding operation results in a ridge of slag formation both inside and outside of flue. This is $\frac{3}{16}$ in. to ¼ in. wide and about the same height. The flues or tubes are rolled to the stripper, a machine developed to remove this flash slag formation from both the inside and outside of the flue or tube. All slag is removed down to the parent metal. Our welds are not hammered or rolled.

After the stripping-machine operation the flues and tubes are cut to proper length, loaded in a rack, annealed, and transported to stock or the the boiler to which they are to be applied. No flues or tubes are tested before being applied to the boilers.

Only two of our major shops are equipped with the new welding and stripping machines and they have only been in service a few months. The performance so far has demonstrated the safety of all welds and has also demonstrated that all the flues and tubes reclaimed for locomotives on our entire system can be reclaimed at these two major shops, which involves approximately 120,000 to 125,000 flues and tubes per year.

Application and Maintenance of Flues

While all methods and maintenance practices followed on our railroad are believed to be good and sound, we are still looking for something better for flues and tubes, something that will give us a longer life without the leakage we experienced from fire cracked beads, flues grooving off just inside the front flue sheet, failed seal welds, and damage from cinder wear.

The successful performance of flues and tubes involves good practices when preparing them for application, such as proper annea'ing, swedging, cutting off to length for the proper amount of metal to form good beads (which should be small), good snug fits of flues and tubes in their holes in the tube sheet to get away from all excessive cold working necessary to get them tight in sheet, and proper seal welding of beads.

Our 2-in., 2¼-in., 3-½in. and 4-in. flues are set in the firebox end with sectional tube expanders, allowing

One of the Union Pacific's flue shops, showing a new automatic flue welding machine at the left and a stripping machine for removing flash slag formations at the right

3/16 in. for beading. We then expand the 2-in. and 2¼-in. tubes with a sectional tube expander, turning the expander three times. A form A expander is used for this operation, and then the bead is formed with standard beading tools. All 3½-in. and 4-in. flues are expanded with a three-way roller expander, allowing 3/16 in. for beading. All 5⅜-in. and 5½-in. flues are set with a straight roller expander, just rolling them enough to fit snugly in the holes, and then they are rolled with a three-way roller expander, allowing 3/16 in. for beading. All flues and tubes in the front tube sheet are rolled with a roller expander, allowing 3/16 in. for beading, and all 3½-in., 3¾-in., 5⅜-in. and 5½-in. flues and 20 per cent of the 2-in. and 2¼-in. tubes are beaded.

The back tube sheet is sand blasted before the application of flues and tubes and all flue beads are seal welded in the firebox end before the locomotive is released. The boiler is not filled with warm water when seal welding flue beads.

All flues and tubes are applied without copper ferrules and very good service has been obtained in combustion-chamber engines. However, in short fireboxes with straight back flue sheets the service results are not as satisfactory as the flue beads crack more quickly than in combustion-chamber locomotives. The advantage of copper ferrules in any back flue sheet is that after the flue beads start to crack longitudinally they can be temporarily repaired by rolling.

By making repairs when the flue beads start to crack by chipping off the bead flush, countersinking the sheet with an air hammer and flat chisel, being careful not to damage the end of the flue to the depth of the countersink, and flush weld, which should be done without flaring the end of the flue, the flues or tubes are conditioned to finish their mileage with less trouble than where copper ferrules are used.

The maintenance of flues, or the repairs necessary at monthly inspection periods on the Union Pacific, is governed largely by the territory in which the locomotives work and the service conditions. First, flues and tubes must be kept clean for successful performance. The practice is followed of washing all flues which accommodate superheater units on coal-burning engines and blowing with air all flues and tubes on oil-burning engines. It is sometimes necessary to wash the tubes even on oil burners. It is a good practice to tighten flues and tubes in flue holes with sectional expanders at given periods, depending both on water and service conditions.

Questions and Answers On Locomotive Practice

By George M. Davies

(This column will answer the questions of our readers on any phase of locomotive construction, shop repairs, or terminal handling, except those pertaining to the boiler. Questions should bear the name and address of the writer, whose identity will not be disclosed without permission to do so.)

Spun-Steel Wheels

Q.—How are spun-steel tender-truck wheels manufactured, and is this type of wheel rolled or cast?—A. C. D.

A.—Spun-steel wheels are cast steel. They are produced in assembled metal molds which consist chiefly of heavy steel rings machined to the proper contour. The entire rim section of each wheel is encased within these steel-ring molds when spun. Molds, with the wheels in horizontal position and assembled in horizontal spinning tables, are poured from the center with great rapidity. High pressure is thereby exerted on the metal in the rim as the result of the centrifugal force produced. The manufacturing principle involved produces and maintains high centrifugal fluid compression during the entire period in which pouring and solidification of metal takes place. For the purpose of further explanation and to differentiate from centrifugal operations which may have been employed in the past, it is particularly pointed out that the spun process described above is predicated on the utilization of high pressure made possible by the metal ring molds. This, in turn, is intended to have a definite effect on producing desired characteristics throughout the rim, plate, and hub portions of the wheel with reference to uniformity, density, and relief of work strains and stresses.

Centering Force for a Rocker-Type Centering Device

Q.—I was interested to read on page 192-3 of your issue of April, 1947, the answer given to the question on "Engine-Truck Centering Devices", but I beg to disagree with the centering force calculated for the rocker-type arrangement when deflection of the truck has occurred.

I have not had experience with this type of centering device, but I understand that the upper arc of the rocker is part of a circle having the same center as the lower bearing surface on the opposite side. If so, as deflection occurs, this center moves along a line parallel to the inclined surface of the rocker bearing and 8¾ in. (that is $\sqrt{(3\frac{1}{4})^2 + (8\frac{1}{8})^2}$ away from it. For the inclined surface to be at right angles to the direction of the resultant thrust in the rocker, a very desirable feature, the taper of the rocker bearing would be 3¼ in. in 8¾ in. measured along the incline (sine α). However, for any deflection, the ratio of restoring force to vertical weight on the truck is surely as 3¼ in. to 8⅛ in., (tan α), the same as when the truck is central. Fig. 1 illustrates 2-in. and 4-in. deflections.

The restoring forces for both rocker and swing link-hanger types of centering devices are shown in Fig. 2.

In the case mentioned, it would be very interesting to learn the reason why the change was made from swing-link hangers to

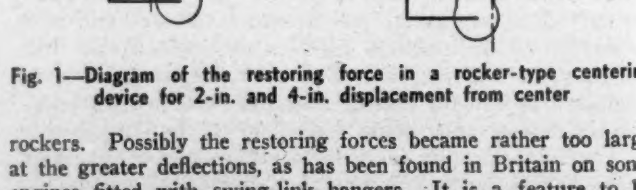


Fig. 1—Diagram of the restoring force in a rocker-type centering device for 2-in. and 4-in. displacement from center

rockers. Possibly the restoring forces became rather too large at the greater deflections, as has been found in Britain on some engines fitted with swing-link hangers. It is a feature to be avoided, particularly when the truck is a two-wheel one, unless friction is introduced deliberately to reduce the restoring force at the expense of increasing the force when the deflection of the truck is increasing.

In Britain, compensation of weight of locomotives is not popular. In engines not compensated and with trucks having centering devices in which the centering forces are solely dependant upon the weight carried by the truck, the engine is lifted by the truck when deflection occurs and a redistribution of weight occurs. This may be serious; the existing forces of the device are correspondingly increased; the life of the springs carrying the trucks may be appreciably reduced; when such devices are used at each end of an engine, a considerable loss of adhesive weight occurs on curves so

that slipping when pulling heavily is not uncommon in these circumstances.—J.C.L.

A.—To change the slope of the top bearing from 3¼ in. in 9¾ in. to 3¼ in. in 8¾ in. measured along the incline, as outlined in the question, would defeat the

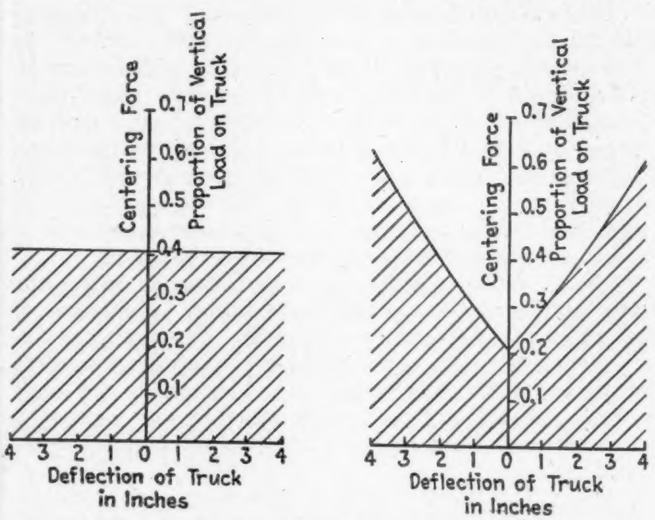


Fig. 2—Left: The restoring force in a rocker-type centering device with a taper of 3¼-in. in 8¾-in.—Right: Restoring forces in a hanger-type centering device

purpose of this type of centering device, in that the initial and constant resistance of the truck would be 40 per cent at all times. This type of centering device is designed so that the initial resistance will be greater than the constant resistance for reasons stated in April issue.

Air Brake Questions and Answers

The 24 RL Brake Equipment for Diesel-Electric Locomotives—Parts of the Equipment—Locomotive A Unit

Description of the S-40-D-Brake Valve Parts

566—Q.—How is the shaft movement controlled? A.—As shown in Fig. 10, handle *42* engages driver shaft housing *6* and controls movement of shaft *11*, which has a cam, shown in Section *C-C*.

567—Q.—In which position can the handle be inserted or withdrawn? A.—Release position.

568—Q.—In what position is the cam at its lowest point? A.—In release position as indicated by handle stop *4*, in which position the cam is at its lowest point releasing pressure on dog *72*.

569—Q.—What happens when handle is moved to the right? A.—Brake application as obtained by moving the handle to the right, which action increases cam pressure on dog *72* and pusher *68*.

570—Q.—What is attached to pusher 68? A.—Balance levers are attached to pusher *68* with roller *69* pivoted on exhaust valve *64*. The lower end of the balance lever pivots on inlet valve *50* through push rod *70*.

571—Q.—What does the balance lever control? A.—The self-lapping function of the brake valve, to be explained later.

572—Q.—To what is the exhaust valve seat connected? A.—The exhaust valve seat, which is located in piston *59*, is connected by a series of holes to the spring cavity which is open to the brake valve exhaust.

573—Q.—To what is the interior chamber of the brake valve connected? A.—To the independent application and release pipe *20*. This connection is controlled by the cam *11* through dog *15*, to hold application valve *25* unseated.

574—Q.—In what position is the application valve unseated? A.—All positions of the brake valve handle except locking position.

575—Q.—Describe the operation of the brake valve handle. A.—The brake valve handle is hinged by cam roller *77* and is held upward, as shown, by spring *10*. Independent release is obtained by depressing the brake valve handle on bail *37*, Section *A-A*. Lower spring *106* normally holds pilot valve *105* and release valve *22* seated, closing off main reservoir supply, and upper check valve *17* unseated, opening the actuating pipe to atmosphere. When the handle *42* is depressed on the bail *37*, plunger *20* seats check valve *17* and unseats pilot valve *105* and release valve *22* permitting main reservoir air to flow to the actuating pipe.

576—Q.—What does locking position consist of and what may it be used for? A.—Locking position consists of a slot in the handle guard *34* at the extreme left and may be used to retain locomotive brake cylinder pressure lower than that in the car brake cylinders.

577—Q.—How is this accomplished? A.—This is accomplished by depressing the handle at the desired point in the application zone and quickly moving to locking position. Plunger *20* seats valve *17* and unseats pilot valve *105* and release valve *22*, holding any desired pressure in the brake cylinders.

578—Q.—What else happens in this position? A.—Dog *15*, falls on the lower stop of its cam, permitting valve spring *28* to seat application valve *25*, closing the independent application and release pipe.

579—Q.—What holds controlled emergency valve to its seat and in which positions? A.—Controlled emergency valve *24* is held seated by its spring in all handle positions except full application.

580—Q.—What occurs in full application position? A.—A cam on the handle shaft engages the valve stem and unseats the valve, opening the controlled emergency pipe to the exhaust.

581—Q.—What effect does this have? A.—This nullifies the controlled emergency feature in full independent application position.

Combined-Auxiliary, Emergency and Displacement Reservoir

582—Q.—What type reservoir is used with this equipment? A.—A combined auxiliary emergency and displacement reservoir (Figs. 11 and 12).

583—Q.—Why are these three reservoirs combined? A.—In order to provide for installation in the least possible space and keep the weight as low as practical.

584—Q.—How does the auxiliary reservoir function? A.—It is the local air supply used with the control valve to provide for proper functioning of the service portion and operate the relay valves to apply the brake.

585—Q.—How does the emergency reservoir function? A.—It is the local air supply used with the control valve to provide the quick recharge, graduated release and high emergency pressure features.

586—Q.—What does the displacement reservoir provide? A.—The required operating volume to develop the proper relation of brake pipe reduction.

587—Q.—How does this reservoir function in conjunction with the control valve operation? A.—The control valve operates to admit air to or exhaust air from this reservoir, the application and release rates being controlled by chokes *3* and *8* in the control valve pipe bracket.

588—Q.—What happens when a brake application is made? A.—When a brake application is made, the diaphragm is deflected, increasing the volume so that the initial rate of pressure development is uniform with that of existing brake equipment.

589—Q.—What is the K-2 *Rotair Valve?* A.—A selector valve with three positions. Fig. 13.

590—Q.—What are these positions and how are they used? A.—Freight-marked "FRGT" when the locomotive is hauling a long freight train. Passenger "PASS" on short trains. Lap position, marked "LAP". The rotair valve handle is placed in this posintion on all locomotive units in a train other than the locomotive from which the brakes are controlled.

591—Q.—Where are the three handle position markings located? A.—The three handle position markings "FRGT", "PASS" and "LAP" are located on the handle side of escutcheon plate *25*.

Locomotive Balancing Table

Most railroads are confronted with the serious problem of being unable to obtain a revised weight distribution after additions are made to locomotives or after they are rebuilt in railroad shops. The exception is where the shops are located near a builder's plant having scale equipment available for determining the weights to locate the longitudinal center of gravity.

The Canadian Pacific found that even moving locomotives to a builder's plant was costly as it involved crew wages and shipping charges. It also found that the use of a turntable on which to balance a locomotive and determine its longitudinal center of gravity was unsatisfactory because a turntable does not have a proper pivot point.

These difficulties were overcome by the C. P. by the construction of a balancing table at its Angus shops, Montreal, Que., Canada. The table, shown in the illustration, has two main side-frame members 58 ft. long that were made from discarded bridge girders. The distance between the center line of the girders is 15 ft. 6 in. The girders are braced transversely at the bottom by seven 15-in. I-beams. The rails are laid on 48 crossties 10 in. wide, 18 in. high and 15 ft. 6 in. long that rest on the bottom angles of the girders.

Two-inch planking covers the ties between the outside of each rail and the inside of each girder.

The table is balanced on two 6-in. pins, 15 in. long, one pin directly under each girder at the center of the table. The table is supported at each corner by a cam arrangement, shown in the foreground of the illustration, which permits the ends to swing free when all cams are displaced by means of the levers. A pointer at the center of the table indicates the balanced position of the table when it centers on markings painted on a plate that is supported by the center pier. This pointer is centered by moving the locomotive until the table is balanced.

The Canadian Pacific has found that by using this table and an ordinary track scale that a locomotive can be weighed quickly and accurately. This railroad has checked several lots of locomotives coming from builders' plants on the balancing table. The locations of the longitudinal center of gravity as determined by use of the table have been within ⅛ in. to ¼ in. of those obtained by the builders.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Removal of Flame Cutting Restrictions

Q.—I am referring to a question which appeared on page 81 of the February, 1947 issue of the *Railway Mechanical Engineer*. Could you refer me to the published reports of the investigation as well as to the code-making bodies which have removed all

Locomotive balancing table at the Angus shops of the Canadian Pacific

restrictions pertaining to welding on the edges of surfaces that have been prepared by flame cutting?—E. R.

A.—The 1936 & 1937 Official Proceedings of the Master Boilermakers Association included a paper on "The Effect of Flame Cutting Upon Steel Boiler Plate" by the Research Committee of the International Acetylene Association. This committee reported that the A. S. M. E. Boiler Code Committee has removed all restrictions in the Boiler Code pertaining to welding on the surfaces that have been prepared by flame cutting. The rules now state that plates may be cut to size and shape by a flame-cutting process, provided the carbon content of the steel does not exceed 0.35 per cent. These rules stipulate further, however, that gas-cut plate edges must be uniform and smooth and that all loose scale and slag accumulations must be removed from them before welding. It is expressly stated in the Boiler Code that the discoloration which may appear on the gas-cut surfaces is not considered to be detrimental oxidation.

Computing Strength Of Copper Tubing

Q.—The top connection of the water column is connected to the extension on the top of the firebox with 1½-in. outside-diameter copper tubing. We are now using No. 12 B.W.G.-gauge copper tubing. Is this tubing satisfactory for a working pressure of 275 lb. per sq. in.?—F. E. B.

A.—The bursting pressure of seamless copper tubing may be estimated by using the following formula:

$$\frac{\text{Tensile strength of metal, lb. per sq. in.} \times \text{thickness of wall, in.}}{\text{Radius of tube (½ outside diameter), in.}} = \text{Bursting pressure}$$

Substituting in the above formula, we have

Thickness of wall, No. 12 B.W.G. = .109 in.

$$\text{Radius of tube, } \frac{1.5}{2} = .75 \text{ in.}$$

Assuming the tensile strength of annealed copper tubing to be 30,000 lb. per sq. in., and substituting in the formula:

$$\frac{30{,}000 \times .109}{.75} = 4{,}360 \text{ lb. bursting pressure}$$

$$\frac{\text{Bursting pressure, lb. per sq. in}}{\text{Working pressure, lb. per sq. in.}} = \text{factor of safety.}$$

By substituting we have:

$$\frac{4360}{275} = 15.8 = \text{factor of safety.}$$

The 1½-in. outside-diameter No. 12 B. W. G. gauge copper tubing would be satisfactory for a working pressure of 275 lb. per sq. in. It is the general practice to have a high factor of safety for copper tubing located inside of the cab.

Electric Welding Nickel-clad Plate

Q.—Does the procedure for electric welding nickel-clad plate differ from that for carbon-steel plates?—F. I. R.

A.—In general, the procedure for welding nickel-clad plate differs only from welding carbon-steel plate in that the nickel side of the plate requires nickel metallic arc welding wire. The preferred procedure in welding nickel-clad plate, particularly with a beveled joint is as follows:—Assemble the structure by tacking from the steel side; complete the weld on the nickel side with a single bead; chip out the tacks and clean to the root of the bevel; complete the weld on the steel side.

In shops where bevelling is done by hand chipping, it is usually desirable to weld the steel side first to avoid the possibility of burning, through uneven welding, and other difficulties arising from variations in the separation of the joint and the thickness of the lip at the root of the bevel. The accustomed practices prevailing in the shop, including size and type of welding rod, current adjustment, and manipulation peculiar to individual operators, are used without important modifications in welding the steel side of the plate. The skilled operator should have no difficulty in welding the nickel side. The principal point to be observed in the preparation of the points, assembly, and welding are:

1—The edges of the plate should be planed to give uniform alignment of the joint.

2—Beveled butt joints should be assembled with the edges of the bevel at the lip closely butted.

3—On joints welded first from the steel side, the nickel side should be cleaned free from "icicles" slag and heavy oxide. It is advisable to chip the seam with a round-nose chisel to a depth necessary to expose sound metal at the root of the steel weld.

4—Use nickel metallic arc welding wire for welding the nickel side.

5—The operator should make trial welds with reversed polarity at several current values, and select the amperage that best suits the nature of the work and his own manipulation methods.

6—A short arc, 1/16-in. to ⅛-in. long, is an absolute necessity.

7—The selection of the size of electrode and the adjustment of the welding current must properly balance the penetration and rate of electrode fusion.

Effect of Heavier-Gauge Safe Ends on Life of Flues

Q.—We have considerable trouble with the tubes and flues cinder cutting at the back tube sheet. Can the service of the flues and tubes be lengthened by applying safe ends of a heavier-gage than the tubes and flues now in the boiler?—F.E.D.

A.—The use of heavier-gauge safe ends at the firebox end of the tubes has resulted in the life of the flues being considerably prolonged, provided the thickness of the safe ends is not increased to a point where it causes fire-cracking of the flue bead due to the heavier-gauge safe end.

Quality of Steam

Q.—What is meant by the term "quality of steam"? How is it determined in a locomotive boiler?—F.R.N.

A.—Wet steam is a mixture of saturated steam and liquid at the same temperature. The quality of the mixture is the per centage of its aggregate weight which is saturated steam. Road tests of locomotives show an average quality of 95 per cent for the saturated steam delivered to the superheater. The quality is determined by means of a steam calorimeter receiving steam from an appropriate sampling nozzle in the steam space. A type frequently used in locomotive test work is the throttling calorimeter, the essential details of which are a throttling orifice admitting steam into the expansion chamber of the calorimeter, and a thermometer well inserted into the expansion chamber so as to be entirely surrounded by the low-pressure steam from the throttling orifice. It operates on the principle that when steam passes through an orifice from a higher to a lower pressure the total heat of the steam remains unchanged, providing there is no loss due to radiation. There are various commercial forms of this type of calorimeter.

ELECTRICAL SECTION

Eliminating Axle Breakage

By E. D. Hall*

Erie is now using Sperry Reflectoscopes to detect flaws in axles and crank pins, and has disposed of arbitrary axle replacements

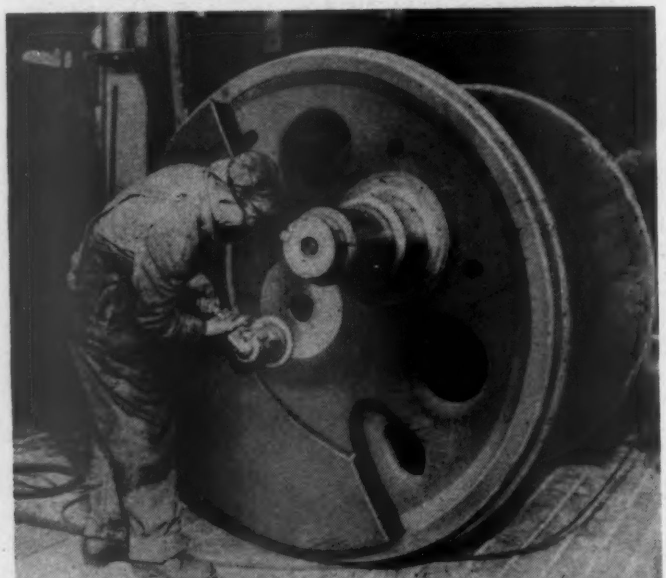


Fig. 1—The end of the axle is polished with a portable emery disc polishing machine to eliminate stamp marks and nicks, before the tests are made

On February 18, 1946, a Sperry Supersonic Reflectoscope made by Sperry Products, Inc., was placed in service at the Erie general repair shop at Hornell, N. Y., and instructions were given our men by Sperry representatives in the method of detecting subsurface defects in locomotive axles and crank pins.

The results obtained have not only increased axle and pin life with consequent saving in material and labor costs, but have increased the safety of train operation, and reduced out-of-service time of locomotives caused by axle breakage in service.

Originally, it was the railroad's practice to permit axles to run until they were worn to the condemning limit in the journal, or a crack or other defect was located visibly.

One peculiarity of fatigue failure is the lack of outward evidence that the material has been over stressed to the point where it is approaching failure. Examination by eye, magnetic particle methods or Reflectoscope may not disclose a fatigued condition, yet the steel may fail in a comparatively short time after inspection.

Cause of Failures

Some means of detecting the presence of a hidden crack was highly desirable since experience has shown that there is no reliable figure which can be placed upon the safe mileage of any locomotive axle. Quality of steel used—its heat treatment, its finish at the time of installation and the condition of fillets after wear has taken place,—all have some bearing on the expected life. By far the largest single factor, however, is overstressing the axle. Improper setting of wedges, worn rod bearings, valves out of square, improper drifting, wheels out of balance, tires worn out of round, wheels out of quarter, poorly aligned turntables, worn railroad crossing frogs, low joints and other bad track conditions all result in stressing the axle beyond the theoretical limits set up by the designer. Any one of these conditions may be present for a short time in the life of an axle, or combinations may be present which temporarily greatly overstress the axle. Since axle failures are in most cases the result of fatigue, any increase in stresses above the endurance limit causes early failure if the stresses are repeated often enough. Proof that this condition exists is shown by the following list of failures of main driving axles under 2-8-4 locomotives, all of the same class.

* Engineer of Tests and Chief Chemist, Erie Railroad.

Table I

Axle Failures on 2-8-4 Locomotives

Age			
Years	Months	Mileage	Per cent of cross sectional area cracked before failure occurred
	8	26,642	80
1	11	53,689	90
2	3	64,353	70
1	9	76,348	70
1	5	77,468	80
2	7	80,553	80
2	4	86,237	50
4	..	120,920	70
3	5	121,326	80
5	1	151,117	65
5	3	263,051	90
6	7	300,051	60
6	7	300,188	60
7	6	335,304	75
7	..	337,630	80
9	0	405,668	80

It will be seen from the table that failures occurred in service with mileage as low as 26,642, and as high as 405,668.

Each failure was investigated and in only a few cases was the quality of steel thought to have any direct in-

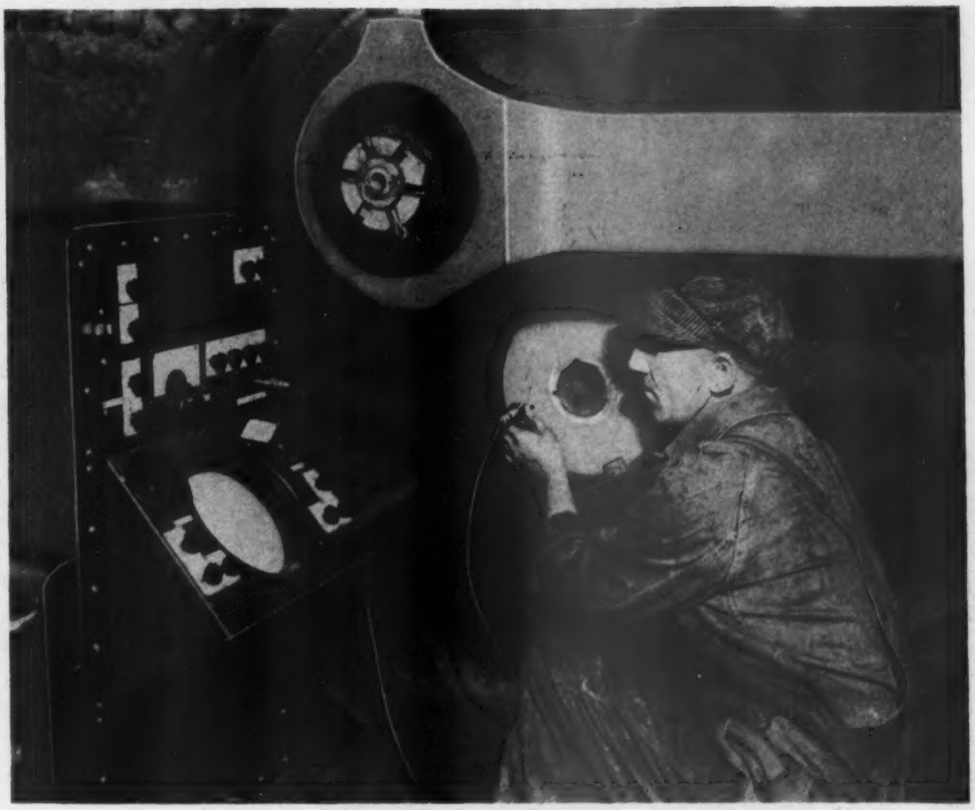


Fig. 2—The searching unit being applied to the end of an axle while the operator watches the oscilloscope screen

fluence on the failure. All axles were purchased to the same specifications and were checked by inspectors. One axle referred to above contained numerous small bursts,

Fig. 3—Method of using the Reflectoscope on a crank pin

which could only be detected by microscopic etch test, which was not at that time being used.

Analysis of failures on heavy freight engines of the class mentioned above and other similar classes developed that the average mileage of main axles at time of failure was 250,000 miles. It was decided to set up an arbitrary mileage limit on all locomotive axles and crank pins. Since locomotives were being run 120,000 miles between Class 3 repair periods, we set 240,000 miles for main axle replacement and various multiples of 120,000 for other than main axles and pins. It can readily be seen that this method could not hope to prevent all axle failures, and a certain number did occur. On the other hand many axles were renewed, which could have made additional mileage.

Use of the Reflectoscope

It was thought possible that the Reflectoscope might locate cracked axles readily and without the necessity of removing wheel centers from axles or pins from wheel centers, and on February 18, 1946, a Sperry Supersonic Reflectoscope was placed on test at the general locomotive repair shop at Hornell, N. Y.

This machine transmits a beam of supersonic sound waves from one end of the piece to be tested longitudinally

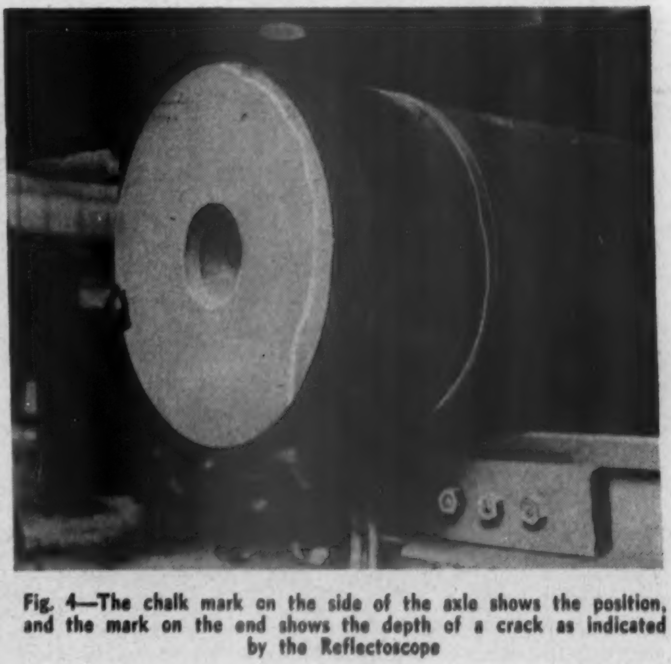


Fig. 4—The chalk mark on the side of the axle shows the position, and the mark on the end shows the depth of a crack as indicated by the Reflectoscope

through the piece. These waves are reflected from the opposite end of the piece and are picked up electrically at the point where they start. The movement of the waves from the point of origin, and the point where they are reflected is shown on a ground glass screen. If any crack, subsurface defect, or any other condition is present, which interferes with the passage of the waves through the piece, the location of this defect is immediately shown as a new indication on the screen.

The operation of the Reflectoscope is quite simple. It can be used at any location where electric current is available. The operator can be a machinist, electrician or other regular employee who can be instructed in a very short time.

Before tests are made on axles or crank pins, the end of the axle or pin to which the searching unit of the Reflectoscope is to be applied, is polished by means

Fig. 5—For the purpose of testing, locomotives are spotted so that the rods are not over the axles

of a portable emery disc polishing machine to eliminate stamp marks and nicks, which would damage the crystal of the searching unit or prevent making a full contact. This is shown in Fig. 1. A film of machine oil is applied to the polished surface and the searching unit is placed in contact with the end of the axle or crank pin, as shown in Figs. 2 and 3.

Outlines of Defect can Be Traced

While the searching unit is moved from one spot to another on the end of the piece to be tested, the visible indication of sound wave reflections is observed on the Reflectoscope. Any sub-surface condition is noted and if one is found, the operator follows the limits of this indication, thereby tracing the transverse pattern of the defect on the end of the axles and notes the longitudinal distance from the searching unit. The indications can be checked as often as desired.

Figure 4 shows the outline of a crack in a driving axle marked to show the indications of the Reflectoscope, while the wheel was still in place. This axle was pressed out of the wheel center, Magnafluxed and photographed with the Magnaflux powder adhering to the actual crack. As can be seen from the photograph, the crack is in the wheel fit and could not be located by other means without removing the wheel. Many axles cut up to verify indications of the Reflectoscope have shown that in most cases the Reflectoscope indication showed cracks to be very slightly deeper than the actual cracks found. This is considered of advantage.

Crank pins and axles can be tested in locomotives in roundhouses or other locations without removing side

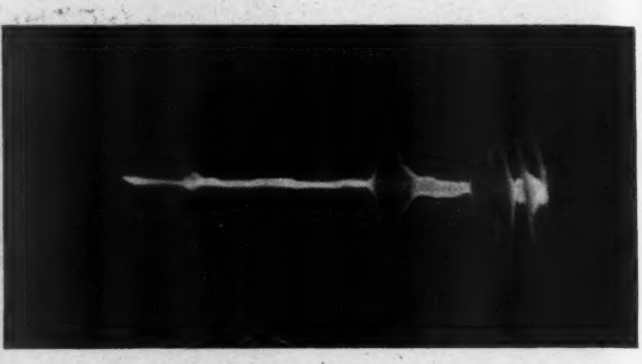


Fig. 6—Typical reflectogram obtained when testing a defective axle—The peaked indication on the left is the initial pulse as the sound waves enter the axle—The high peak at the right is the reflection of sound from the opposite side of the wheel seat and the center peak is the reflection from a crack in the wheel seat—In a good axle the center peak will not appear

rods or dropping wheels. Figures 2 and 5 illustrate how engines are spotted for making tests.

Test Results

Since the installation of the first machine at Hornell backshop, 1,688 axles and 861 pins have been tested. Of this number, 74 axles and 26 pins have been found defective and replaced saving possible failures.

In addition, 57 axles having mileages beyond the previous condemning limit have been tested and found satisfactory for further service and have produced additional mileage amounting to 2,694,349 miles to June 1, 1947, which is the equivalent of the previous mileage of 11 axles. Thirty-eight of these axles are still in service and accumulating additional mileages, which result in additional saving. As time goes on, more and more axles having mileage greater than the previous limit will be in service and greater savings will be made.

New axles and pins are being tested before they are applied to locomotives and consideration is being given to the installation of additional machines in car shops to check car axles before applying wheels.

Since we had 337 locomotives larger than switch engines with which we had experienced axle-breakage,—and these engines had 1,377 driving axles, 2,754 pins, 466 engine truck and 463 trailer axles,—it was obviously impossible to check these axles and pins often enough to assure finding all cracks before failure occurred.

The only time locomotives could be checked was while they were receiving classified repairs at Hornell. Some locomotives received classified repairs at other terminals. One heavy freight locomotive broke a main axle in service 26,592 miles after it had been inspected. The failure was a fatigue failure. Records indicate no crack existed at 202,836 miles, but that a fatigue crack started and progressed, covering approximately 80 per cent of the total cross section area at the time of final failure. This axle was in service on one of the most powerful 2-8-4 locomotives not equipped with tandem main rods.

We, therefore, purchased two more Reflectoscopes, one being used jointly by the roundhouses at Meadville, Pa., and Marion, Ohio, the other being used jointly by the roundhouses at Jersey City, N. J., and Port Jervis, N. Y. We are now able to test every axle on heavy freight and

passenger power every month, and axles and pins on smaller engines at slightly longer intervals.

Since the installation of the three machines, no axles or crank pins have broken in service. The roundhouses have found a total of 22 axles defective, in addition to those found at the Hornell shops.

The total savings effected by these machines are considerably more than the cost of the axles. Damage to the other parts of a locomotive when an axle breaks may amount to $5,000, while total damage in case of derailment may run into hundreds of thousands of dollars. One thing usually not considered by mechanical officers is the cost of tying up the railroad while the engine is being removed from the scene of the accident. From a transportation standpoint, the elimination of such occurrences is sufficient reason to give serious consideration to any means of preventing road failures.

Other Uses

Additional uses are being found for the Reflectoscope in checking axles on which gears are mounted, such as booster axles, Diesel driving axles, and shafts upon which bushings are pressed, such as Diesel traction motor shafts.

The condition of steel under pressed or shrunk bushings such as inner races of roller bearings can readily be determined without the necessity of removing the bushings or races. It is expected that many more uses will be found for this type of machine in determining condition of metal in places which cannot be seen without dismantling the equipment, which will result in more dependable service at reduced expense.

The A. A. R. Committee on Axles has been conducting fatigue tests on various kinds of steel prepared for use by different methods in an attempt to reduce pin and axle breakage. Results to date seem to indicate greater possible mileage than obtained with plain carbon steel.

The Erie has run, and is running, tests of carbon steel axles with various heat treatments, and has tried out various preparation procedures such as stress relief grooves, rolling wheel fits, etc., and some increase in axle life has been obtained. However, it appears that since so many factors other than material have a bearing on the axle life, it will still be necessary to have a means of detecting fatigue cracks to avoid failures.

Value of Impregnation

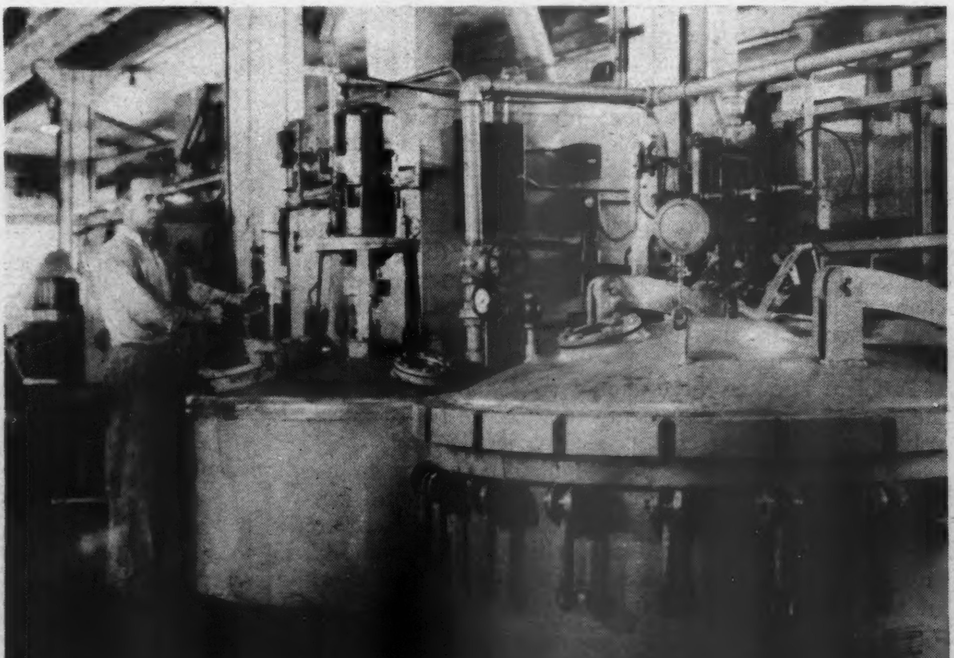
The value of vacuum impregnation of railway traction motors with insulating varnish has long been a source of argument, it being contended by some that the coils are not really impregnated and that dipping in open tanks is equally effective. For the purpose of determining the facts, tests were made recently in the Silvis, Ill., shops of the Chicago, Rock Island & Pacific.

Three traction motors which required rewinding were selected for making the tests. In each case the armature was placed in the impregnator under 28 in. of vacuum for two hours and then the varnish was allowed to enter the tank while still under vacuum and remain so for two hours.

At the end of this time, the vacuum was released and a pressure of 50 lb. applied. Armature No. 1 was left under pressure for four hours, armature No. 2 for eight hours, and armature No. 3 for twelve hours. All three were subsequently baked until the varnish was tacky. The armature coils were then cut off at the end of the laminations and inspected. The tacky character of the varnish made it possible to see just how much penetration had been obtained. The coils of armature No. 1 showed a penetration of $\frac{1}{16}$ in. at the outer surface of the upper coil. The coils of armature No. 2, under pressure for eight hours, showed impregnation through the upper coil but not into the lower coil in the slot. The coils of armature No. 3, under pressure for 12 hours, were impregnated to a point about half way through the lower coil.

The varnish in the second and third cases had entered into and completely through the insulation between all three turns. The type of varnish used was 2 A-100, manufactured by the Sterling Varnish Company.

These results indicated that complete penetration could be obtained in less than 24 hours. Since the shop works only one eight-hour shift, and since the impregnator can therefore be loaded only once in a 24-hour period, it is now the practice of the Silvis shop to allow all armatures to remain in the impregnator for periods of 16 to 24 hours, depending upon the time in the working period it is necessary to load the impregnator. To further assure complete impregnation, the pressure has been increased from 50 to 80 pounds.



Vacuum impregnating tanks at the Silvis, Ill., shops of the Chicago, Rock Island & Pacific

Power Supply for Cabooses*

By E. H. Musgrove†

The fundamental equipment requirements in the order of their importance are dependable power, fulfilment of operating needs, ease of maintenance and acceptable costs

When considering a form of primary power supply for radio-equipped cabooses or way cars, it seems at first glance that the problem is a simple one that can be solved by merely obtaining some equipment that will produce the required amount of voltage and current, and be so constructed that a normal amount of service and performance may be expected with a normal amount of maintenance.

But after going into the problem a little further, it becomes evident that other factors must be taken into account which make the choice of power supply more involved, and the choice for one railroad will not necessarily be the proper choice for another.

It is obvious that the only types of power supply that can be considered at this time are those available today, or that may be available in the immediate future. One manufacturer offered to attempt development on an air-driven device which would obtain its primary power by bleeding a small portion of air from the train line. Assuming that this might be possible, it could not be tolerated because the radio would be inoperative when the train was pulled in two or in switch operations when the radio equipment might be needed most.

Engine or Axle Power

This leaves us with only two basic forms of power from which a choice must be made,—(1) internal combustion engine-driven generators, and (2) battery power. Under the classification of internal combustion engines, we have gasoline, propane and Diesel engines driving d. c. generators or alternators. Battery power can be subdivided into straight batteries, substituted at destination or terminal charged, and battery power, supported by axle-driven generators.

Perhaps the best method of attacking the problem is to itemize all pertinent factors or requirements in the order of their importance;—which again will not be the same order for all railroads because operating conditions, agreements with crafts, climatic and terrain conditions, etc., differ drastically between roads.

Inasmuch as the power supply is basically desired for operating communication equipment, it is assumed that the most important problem for consideration is its ability to deliver dependable power with a minimum amount of failure in service.

Operating problems should perhaps be number two on the list. This does not assume much importance with some roads, but we believe a majority of the railroads are faced with it. It is not an easy matter to effect changes in the operating practices or contracts with the brotherhoods to simplify the communications department's program.

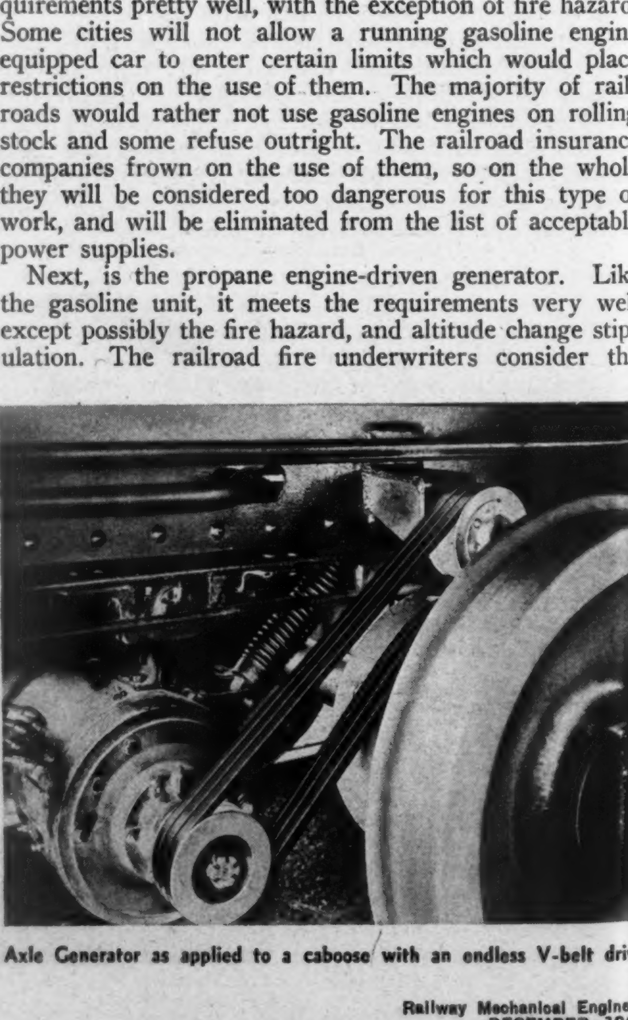
Problem number three should consist of maintaining the power supply equipment,—and last, the costs involved in the use of each type of power.

To obtain dependable service it is necessary to use power equipment that will withstand all adverse conditions to which it will be subjected, of which there are many—changes in temperature, altitude and humidity, dirt, dust, sand, snow, rain, vibration, extreme shock and load variation. It must be capable of delivering power whether the train is moving slow, or fast, or standing for long periods of time. It must be capable of delivering dependable power for long periods of time without attention of skilled workman, and in the case of internal combustion engines, must be easy and simple to start under all conditions. It must be free from dangerous gases, fire hazards, etc. Failure to comply with any one of these requirements can very easily result in failure of communication.

Engine Power

Gasoline engine-driven generators will meet the requirements pretty well, with the exception of fire hazard. Some cities will not allow a running gasoline engine equipped car to enter certain limits which would place restrictions on the use of them. The majority of railroads would rather not use gasoline engines on rolling stock and some refuse outright. The railroad insurance companies frown on the use of them, so on the whole they will be considered too dangerous for this type of work, and will be eliminated from the list of acceptable power supplies.

Next, is the propane engine-driven generator. Like the gasoline unit, it meets the requirements very well except possibly the fire hazard, and altitude change stipulation. The railroad fire underwriters consider the



Axle Generator as applied to a caboose with an endless V-belt drive

* Paper presented at the meeting of the Communications Section, Association of American Railroads in Miami, Fla., October 21-23, 1947.
† Radio engineer, Denver & Rio Grande Western.

propane engine safer than the gasoline engine, but more of a fire hazard than the Diesel. However, I believe it is accepted from a safety standpoint. Our railroad has been using several propane engines on cabooses for two years with no indication of fire risk to date.

Some trouble has been encountered in keeping them operating when extreme changes in altitude are encountered. For instance, one of our caboose service points is Grand Junction, Colorado, with an altitude of 4,580 ft. The engines are checked and adjusted to that altitude and released for service. The train may go west, or east, and if to Pueblo, by way of Tennessee Pass, which has a track altitude of 10,200 ft., more often than we like to admit, the train arrives at Pueblo with the propane engine dead, beacuse of nearly a mile change in altitude.

Another point that may not be inherent in all propane engines, but is evident in those we have worked with, is that of being extremely hard to start in cold weather. Perhaps, the engine manufacturers can work this one out, but it is mentioned as one point to take into consideration before purchasing.

Diesel engine-driven generators will undoubtedly comply with all of the requirements. Our road has had one in service 24 hours a day for a year and a half. The engine operated 10,050 hours continuously before it gave any trouble. After repairing, it has given another 5,000 hours continuous service and is still going. The fire underwriters consider the Diesel engine more of a fire hazard than battery power, but safer than propane or gasoline power.

It is not the writer's belief that any light, highspeed, air-cooled engine can be justified in railroad work. Though they might fuffill the requirements when new, they cannot be expected to last very long, and certain inherent characteristics tend to make their use undesirable.

Compared with water-cooled engines they operate at a disadvantage. It is hard to provide sufficient air cooling in high ambient temperatures, and if this is accomplished, then it is likely that the engine will run too cold in low temperatures. Of course this problem can be compensated for by the use of automatic or manual shutters which will in turn further complicate the installation and maintenance. Then, too, when all this external air is required for cooling, the engine is subjected to more than its share of dirt, sand, and moisture which will materially shorten its useful life.

Also since air-cooled engines run at such high temperatures, they consume much more lubricating oil than do water-cooled units. This results in much shorter running time between servicings which is most undesirable. Use of larger crankcases and pumping the lubricating oil from an externally cooled tank will reduce the oil consumption somewhat, but will not help to any marked degree.

The use of heavy one-cylinder equipment offers the problem of eliminating vibration on the caboose, especially in the case of all-steel cabooses where the engine vibration is transmitted throughout the car with no natural dampening as is present in the wood caboose. We found, however, that by careful choice of vibration dampeners, the caboose receives no more vibration than is caused by small multi-cylinder engines.

In the case of battery power, if we assume that ample provisions have been made to insure that the batteries will not become discharged, no matter what operating conditions they are subjected to, then all requirements will be fulfilled. The insurance companies consider storage batteries, with or without axle generators, the ultimate from the standpoint of fire hazard.

Axle Power

However, providing ample insurance against failure is quite a trick, and must not be treated lightly. Railroads have long been users of axle-driven generators for

Application of a Diesel-engine-generator unit under a caboose

charging batteries, which in turn furnish power for lights, air conditioning and miscellaneous equipment in passenger service. Freight trains offer entirely different problems than passenger trains. These must be overcome to deliver the high standard of performance required by communication service on freight trains.

One of the first obstacles to axle-driven equipment used on cabooses, as compared with passenger service is that of the difference in average speed. This may be compensated for by decreasing generator pulley sizes, but it is impractical to increase the size of the axle pulley over that used on passenger equipment. Caboose wheels are smaller in diameter so the same pulley would have less clearance from the ties. The closer the pulley travels to the ties, the more gravel and snow it will pick up with a consequent increase in belt breakage. Also it is entirely possible for the locomotive to attain a speed of approximately 8 m.p.h. before the caboose starts. No passenger equipment ever offered this kind of strain to its axle-drive belts. All of which simply means that more belt trouble can be expected in freight service than passenger, which is particularly undesirable since railroads are not organized to maintain freight equipment with the same degree of regularity or efficiency as passenger.

Batteries

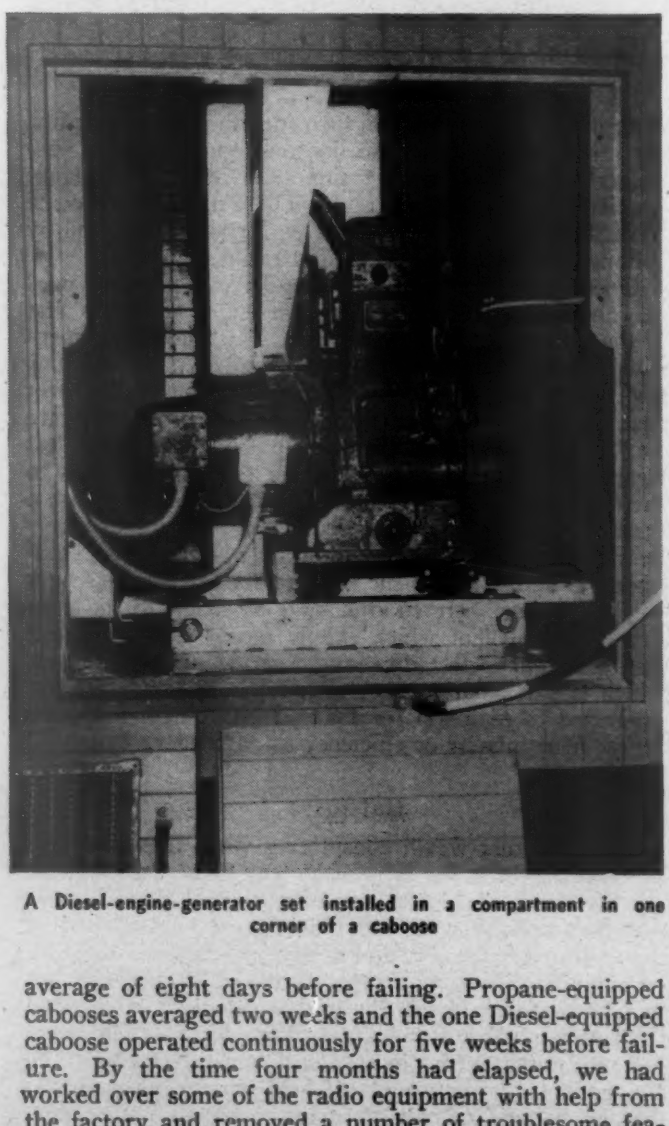
Another point worth considering when installing battery equipment is the type of battery to be used. There are two kinds—lead-acid and Edison types that are considered standard with the industry. The lead-acid is more subject to shock, and if in a discharged state can be ruined by freezing temperatures. Also, there is the item of corrosion which the lead-acid battery offers, and the battery cannot stand a very fast charge. The latter becomes important in the case of terminal charging. The one good point with the lead-acid battery, however, is that its voltage remains relatively constant until a discharged state becomes imminent. On the other hand the Edison type battery can withstand much more shock, is not subjected to freezing when discharged, does not corrode, and can stand very high rates of charge. But, the terminal voltage drops faster than that of the lead-acid battery, and the only way the output voltage can be held constant is to maintain the same degree of charge

at all times, which of course is impossible. This naturally results in poor voltage regulation, which will be discussed later.

Whether terminal charging or axle-driven equipment or both are used for charging, the battery must obviously be of sufficient capacity plus a safety factor to operate radio equipment properly for long periods of time when the train is standing on the main line or is in trouble. It is just such cases where radio is used the most and adequate protection must be provided to insure communication. Battery power is, of course, less efficient than engine generators because of the number of conversions required before voltage is actually imposed on the radio equipment.

Voltage Regulation

A year and a half ago, we placed radio equipment in operation and maintained records on each piece. At that time we found that we could keep radio equipment in operation in Diesel locomotives for something like an average of eight days before failing. Propane-equipped cabooses averaged two weeks and the one Diesel-equipped caboose operated continuously for five weeks before failure. By the time four months had elapsed, we had worked over some of the radio equipment with help from the factory and removed a number of troublesome features. The modified radio units were placed in service and allowed to run to breakdown. This time we averaged 27 days on the locomotives, 40 days on the propane engine cabooses, and 92 days on the Diesel engine caboose.



A Diesel-engine-generator set installed in a compartment in one corner of a caboose

Further modified radio equipment was placed in service in the locomotives and cabooses the first of this year, and our findings to date are: All radio equipment in the locomotives can be depended upon to operate more than two months; on propane engine equipped cabooses two and one-half to three months; on the Diesel engine caboose we do not know. We are now removing the radio equipment on a preventive maintenance basis, to insure against road failure. One v.h.f. receiver failed five days after installation because of a defective tube, but outside of that the equipment in the Diesel caboose has given no trouble whatever. The v.h.f. receiver (which is the most troublesome of all the units) has been in service since the first of the year, however, it was removed from service the middle of August for preventive maintenance although still operating satisfactorily.

To install radio equipment on freight trains is quite expensive, but to properly maintain it may cost up to $850.00 per year, per train. If, by close voltage regulation the maintenance periods could be reduced fifty per cent, as indicated, the radio maintenance costs will be materially reduced.

It is too early to establish definitely the importance of close voltage regulation, but we strongly suspect that it is there. Recorded charts were taken of all power equipment, and we found that the propane engine generators gave us a voltage regulation of $\pm$ six per cent fluctuating approximately once every three seconds above or below the mean 115 volts.

In the case of the Diesel-engine-generator, the voltage regulation held to $\pm$ 1.5 per cent with fluctuations occurring approximately once every fifteen seconds. The Diesel locomotives use 64-volt batteries for power, and fluctuate from 64 volts to 78 volts, or plus 22 per cent with no minus fluctuations, the mean voltage being 64 volts. We have no figures on battery-equipped cabooses that we have taken ourselves, but one railroad communications official states that there is a $\pm$ fluctuation of 19 per cent; another $\pm$ 21 per cent; another $\pm$ 18 per cent. It would be very interesting to make the same tests on battery equipment that we have conducted on our cabooses.

If we can attach importance to the above findings, then we can no longer say that we will accept a caboose power supply with a voltage regulation of $\pm$ 5 per cent, as suggested by radio equipment manufacturers and the A.A.R. It will definitely be to a railroads' advantage to purchase as closely regulated power supply systems as the industry knows how to produce.

Effect of Operating Conditions

Problem number two for discussion is the effect of operating conditions on the choice of caboose power supply. It cannot be hoped that we can solve these problems for other railroads; in fact, we can do nothing to change our own operating system. But we can discuss them and point out why in many instances a secondary choice of caboose power must be made.

In the first place, we understand that the majority of railroads have their cabooses assigned. This is indeed a deplorable situation for radio operation on the main line. When this condition exists, the cabooses are only going to operate over one division and will be in actual road service one-third of the time or less. On the other hand the locomotives are operating the majority of the time, and usually over more than one division. This means that if one locomotive operating over three divisions is radio-equipped, then all cabooses operating over those three divisions must likewise be equipped to protect the one engine. Of course this is a one-sided example, but serves to make the point. When cabooses are assigned, the trainmen live in them when on one end of the

division. It is apparent that the train crew will not want to spend 16 hours in a dead caboose with a plus 46-db. engine background noise.

Of course, if engine equipment were used, the engine could be shut down at the end of the run and started again by the train crew before starting on the next run. This would be perfectly satisfactory if the engine did not give trouble in starting.

Also, as one railroad official pointed out, if ten cabooses were stored in the yard, and men sleeping in them, complaints would be received if crews, preparing one of the cabooses to go out on line, started the engine and allowed it to run for some time before the caboose was removed from the storage track. In an instance such as this, unless the engine could be sufficiently muffled and mounted in a sound-proof compartment, with vibration reduced to a minimum, it is obvious that battery power would be the only answer.

A railroad that uses assigned cabooses has the best to know where a given caboose is at the moment. In chance of recovering batteries by terminal charging when necessary. This is, of course, due to the layover time at terminals. On the other hand, roads that pool their cabooses usually run them nearly continuously and should a battery be down, there is little chance of getting it charged at a terminal unless the caboose is bad ordered and removed from service.

Another bad feature of the pooled caboose system is that there has been a tendency for the transportation people to be quite lax as to what caboose goes on what train and very often it is nearly impossible for them other words, they have been drawing from a pool and it really did not matter what caboose was used. Now, however, with some of the cabooses radio-equipped to match up with radio-equipped engines, it matters a lot which one is selected.

All employes handling the makeup of trains and movements of cabooses after they are taken from a train will have to have systems set up so that they know where the way cars are at all times, and can spot them on the proper tracks so that they may receive power supply servicing as well as radio checking with as little lost time as possible.

Cabooses have in the past been treated practically the same as freight cars, but with radio equipment and power supply equipment to be serviced and repaired, it is going to be necessary to set up special facilities to handle the work. Also procedures for switching and handling of cabooses by the yard forces must be effected.

Though the handling of pooled and assigned cabooses will necessarily be different, and whether pooled or assigned will have a bearing on the type of power supply selected, still the only real advantage that the pooled caboose has over the assigned is that installations can be made caboose for engine, resulting in a far less initial outlay of money.

Maintenance of Equipment

Problem number three is the maintenance of the power supply equipment. Experience accumulated on the Rio Grande shows that the small high-speed engine generator units require far too much servicing and maintenance to justify their lower initial cost. For instance, propane, air-cooled, two-cylinder, 1800-r.p.m. units now in service must have the crankcase oil checked every eighteen hours, with an average of one pint of oil added. A propane bottle must be changed every three days and every ten days the oil must be changed, the starting batteries checked, the engine performance checked and speed, voltage, etc. noted. Then once a month the engine is ready for overhaul, and is exchanged with one from the overhaul shop.

In contrast to this record, the Diesel engine requires servicing once every 10 days, at which time the crankcase is drained; radiator, batteries, speed performance, etc. checked, the engine refueled, and then it is satisfactory for another ten days. About once a year the engine must be shopped for overhaul.

From a maintenance and servicing basis, in comparing the propane, light air-cooled engine with the Diesel water-cooled engine, we find that with fewer servicings on the Diesel we can establish a single service point, which means that all education, supervision, personnel, parts and supplies may be handled at one point only, which simplifies service and maintenance problems. Also the handling of fuel oil is much simpler than the handling of over two hundred pounds of weight for each propane bottle.

In spite of all the additional servicing and multiplicity of checks, the propane engines are inoperative an average of eight per cent of the train miles which is certainly not a desirable record. On the other hand the Diesel was inoperative two tenths of one per cent of the train miles.

The Rio Grande has had no experience with battery equipment on cabooses. However, from information received from other roads and our own electrical men who have had much experience with maintenance of battery and axle-driven generators on passenger equipment as well as battery and generator equipment on Diesel electric engines, we feel reasonably safe in making the following statements regarding the maintenance and failure of this type of power.

After every round trip run, (approximately every five days), the battery water and voltage should be checked, belts inspected and regulation equipment and lamps (when used) checked. When the batteries are discharged it will take about twelve hours of terminal charging to bring them back to normal. When lead acid batteries are used, some repair due to freezing must be expected. Considering that these batteries freeze on passenger equipment and have to be replaced, it is certainly reasonable to expect a greater percentage of replacement on freight equipment because of slower runs, much longer stand-out in sidings, etc., and because the servicing facilities are not nearly comparable to those used on passenger equipment.

A reasonable amount of maintenance can be expected each year on the generator, regulation equipment, and pulleys in addition to the batteries. Then, of course, there are belt replacements. All of the equipment manufacturers are using endless belts working over a part of the axle pulley, so the belts can be easily changed out without dropping the wheels or trucks. Because of curves and keeping the belts in line between the swinging truck and stationary frame (on which the generator must be mounted), the flat belt can best be justified because it can work over a very wide pulley to compensate for out-of-line of the axle and underframe. However, the flat belt is more prone to breakage due to snow and ice piling up on the pulleys, and will not withstand the shock offered by slack action of the train as well as "V" belts. When "V" belts are used, both the "V" side and the flat back of the belt ride on pulleys, or else the belt has to be twisted one hundred eighty degrees. Either practice is very bad and leads to short belt life.

First Costs

The last item of the discussion is that of costs. There are three kinds to be considered. The first and most obvious, and probably the most unimportant, is the

initial outlay of money required to purchase and install power supply equipment. Taking the power equipment in the order in which it has been discussed thus far, we have first—the propane engine driven generator. The purchase price of this unit complete is about $500. To this must be added the installation cost, which will vary widely, depending on the type of installation and standards required by the individual railroad. However, to establish an arbitrary standard on all installations discussed, we can assume an installation cost of $300, making a total of $800 for a complete unit per caboose.

A single-cylinder, 1,200-r.p.m., water-cooled Diesel unit will cost about $1,400, plus a $100 installation cost, based on the previous standard mentioned.

The axle-driven generator battery equipment will cost about $1,500 per unit, plus $1,300 for batteries and about $400 for installation, a total of $3,200 per caboose.

Maintenance Costs

The next cost to be considered is that of maintenance and servicing. The propane air-cooled engines must be serviced about 500 times per year at a labor cost of about $300. The oil and fuel consumption will approximate $465 per year, or a total servicing cost of $765 per year. The engine must be overhauled about 12 times a year at a labor cost of $425, and a materials cost of $420, or a total of $845 per year for maintenance. The total cost for servicing and maintenance for one year would then be $1,600 or more than three times the original cost.

The Diesel water-cooled engine requires servicing about 40 times a year, with a total labor cost of $125. The oil and fuel consumption will run less than $70 or a total servicing cost of nearly $200 per year. The engine must be overhauled once a year with a labor charge of about $35 and about $70 for parts, making a total of $105 for a year's maintenance. This gives an estimated total of $300 per year for both servicing and maintenance, or twenty per cent of its original cost.

Labor costs for servicing axle-driven battery equipment will be about $240 per year. General repairs labor will amount to an estimated $125 per year. Add to this $150 for belt replacement and parts for generator, voltage regulator, pulleys, etc. This amounts to a total of $515 for all servicing and maintenance, or sixteen per cent of the original investment.

Axle or Diesel Power

From the standpoint of reliability and over-all dependable service, the axle drive and the Diesel engine appear comparable. The installation and the annual operating cost of the axle drive are nearly twice those of the Diesel unit, but the life expectancy of the axle drive is probably twice that of the Diesel, and in no case can it be considered exorbitantly high-priced.

As to voltage regulation, the axle-driven equipment cannot come up to that of the Diesel, but if the mean voltage is taken to be around twenty-six volts instead of thirty-two and regulated down to the twenty-six volt, value, the over-all regulation will be close enough to do a very satisfactory job.

The real determining factor, controlling choice of caboose power supply, will in most cases be a part of the operating problems involved on the individual road. In any case, the servicing and maintenance costs of both the power supply and radio equipment must be considered.

I am indebted to the Santa Fe, Missouri Pacific, New Haven, Rock Island, Milwaukee, and Boston & Maine railroads and the Eclipse-Pioneer and Witte Engine manufacturers, for help given in the preparation of this paper. On the Rio Grande, all of our first hand experience with caboose power has been in the engine-driven generator field. For this reason, I find it hard to make comparisons with battery power. In spite of help from those who have had experience with this type of power, we cannot be sure that their conclusions would necessarily coincide with ours because of the difference in operating conditions, altitude, climate, etc., I sincerely hope we are not being unfair to any manufacturer's equipment.

Signal Lights And Sealed-Beam Headlights

The Seaboard is equipping its original Diesel-electric passenger locomotives with Mars Figure-8 signal lights and pairs of sealed-beam headlights. The locomotives were equipped orignally with headlights having one 250-watt lamp and a 14-in. glass reflector. A special front-end construction of the locomotive made it impossible to mount the stationary headlight in the door at the front end, and the question of how to mount both units was referred to the Mars Signal Light Company.

The solution of the problem was an innovation in headlight practice. The existing stationary headlight housing was modified to accommodate a Mars WR-5000-A light and to also permit the placing of two 200-watt, 30-volt, sealed-beam lights just below the signal light.

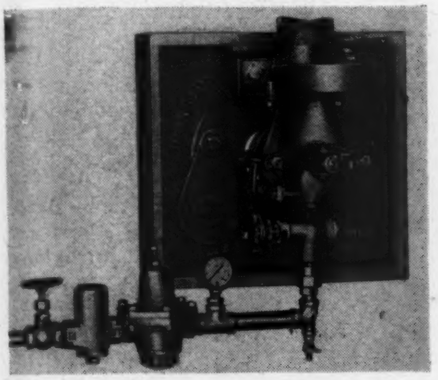
These lights each deliver an initial beam candle power of from 200,000 to 210,000 and they offer the advantage of producing light in the case of failure of one filament.

Front end of a Seaboard Diesel-electric passenger locomotive showing the arrangement of the signal light and the two sealed-beam lamps which constitute the stationary headlight

NEW DEVICES

Oil Burner with Proportioning Valve

Johnston proportioning burners were designed to fill the demand for a simplified oil burner that can be manually or automatically controlled by one lever. They consist of the standard Johnston Reverse Blast Oil Burners with the Johnston Fueltrol Proportioning Valve attached with



The Johnston Proportioning Burner for automatic control

a synchronizing mechanism so that the air and oil balance is maintained in the same ratio at any setting between low and high fire by one lever control. With automatic control several burners can be used on one furnace and all control motors operated in unison by a system of simple relays controlled by a pyrometer.

This product of the Johnston Manufacturing Company, 2825 East Hennepin avenue, Minneapolis 13, Minn., has the proportioning control valve attached to the burner. The valve orifice and mechanism are so arranged that the oil flow can be set for a low fire when the burner air adjustment is at its low setting. With the air and oil adjustments manually set at this point, the operating linkages of the valve and burner are locked in position. When locked, the burner air control can be shifted for a high fire and the linkage attached to it adjusts the oil regulating valve to the high-fire position. The design of the valve and linkages are said to be such that the burner will then maintain the correct air and oil ratio anywhere between the high and low setting. Once set, the burner will produce the required atmosphere and temperature in the furnace and will need no further adjustment. Various types of electric or air-operated motors can be mounted for automatic control. With this sort of arrangement any one of a number of pyrometers can be used to control this burner automatically.

Oil can be delivered to these burners at regular line pressures. A reducing and regulating valve will reduce this pressure to whatever is required at the burner. When they are installed for manual control the furnace temperature can be raised or lowered by the single lever adjustment and the furnace can be shut down and relighted at any time without further readjustment. For automatic control a large motor can position several burners simultaneously through connecting rods attached to a central pivoting shaft, or a small motor may be installed for each burner. These burners are available in a wide variety of sizes for open applications, and for closed applications on Blacksmith forges and flue welding furnaces.

Modified Budd Disk Brake

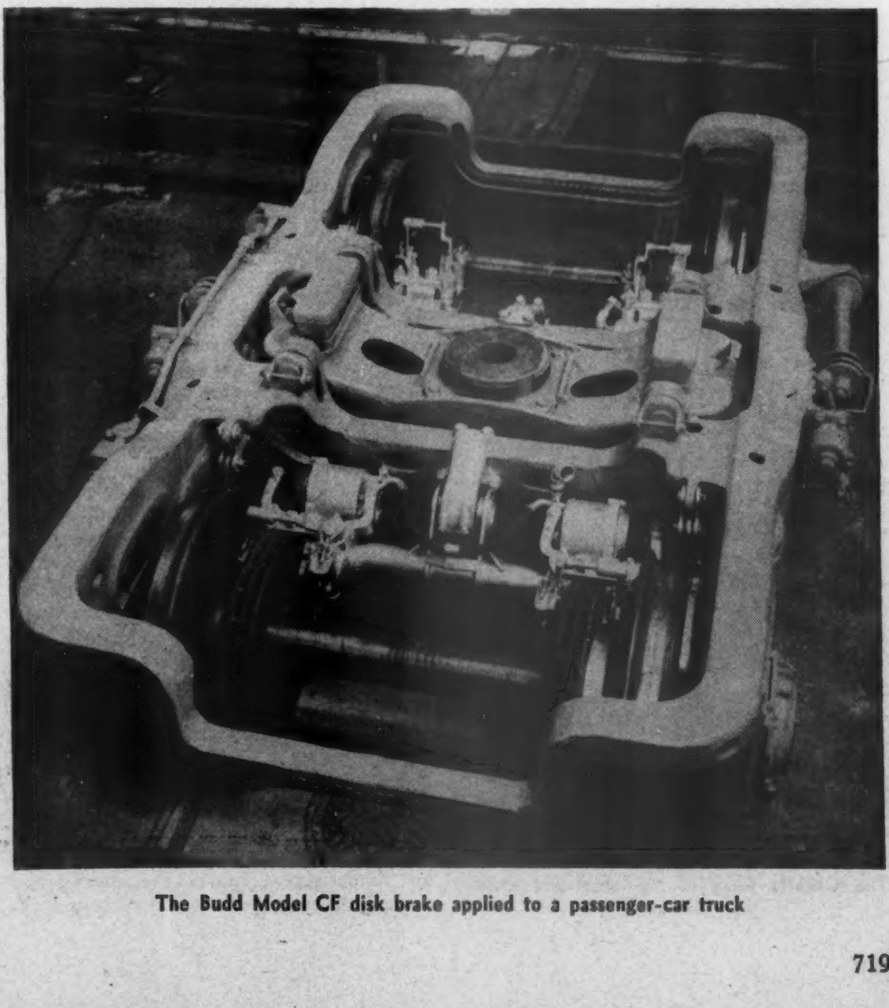
Since the war's end the Budd Company has improved its railway disk brake which has been in service many millions of car-miles. The chief improvement lies in the greater capacity which the brake now possesses for handling heavy inertia loads at high speeds under the greater torques attending rapid decelerations. In addition, the mechanical design of the brake has been refined without departing from its original basic arrangement. The design has been simplified with emphasis on the longevity of wearing parts and accessibility which permits a quick change of brake shoes.

From its inception the chief aim of the brake has been to reduce materially the stopping distances of trains from high speeds. According to the manufacturer, the perfected Model CF disk brake will stop a passenger car without discomfort to its patrons from 60 m.p.h. in less than 1,000 ft.; from 80 m.p.h. in less than 1,600 ft. and from 100 m.p.h. in less than 2,500 ft.

Thermal requirements presented a far greater problem than the development of the greater torque necessary to produce the shorter stopping distances. The total energy is far greater, because of the higher speeds, and because of the overload incident to the underbraking of the locomotive and cars with a lower braking capacity which may be in the same train.

Not only is there a greater total energy to be converted into heat and subsequently dissipated, but the rate of this conversion is much higher due to the higher decelerations and greater mass of energy. The fundamental design of the Budd disk brake was based on the recognition of this problem, with the result that service temperatures of shoe and disk do not exceed critical limits. In this manner heat checking of the disk and dusting of the lining is prevented.

The high insulating quality of the lining of the shoe forces the heat to enter the cast-iron disk, which, by virtue of its rotation, large cooling area and multiple fins that serve as a Sorroco blower, readily dissipates the heat to the atmosphere, without a build-up of temperature sufficient to cause dusting and abnormal brake lining wear.



The Budd Model CF disk brake applied to a passenger-car truck

The brake has sufficient thermal capacity to handle inertia loads of 25,000 lb. per brake, or 200,000 lb. per car, from speeds of 100 m.p.h. This increased thermal capacity, which has been developed from an exhaustive study of shoe design, enables the brake to cope with the imposed overloads which are encountered in mixed train operation.

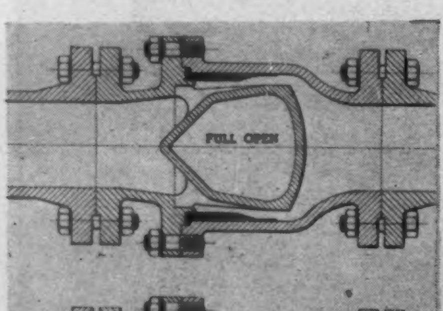
The number of parts has been reduced to a minimum. Spring-loaded and oversize pins and bushings have been employed to minimize wear.

Reports of brake-lining life on the Chicago, Burlington & Quincy Vista Dome cars, with a total weight of 160,000 lb. at the rails, indicate an average of 75,000 to 105,000 miles. Vital parts, such as pins and bushings reveal relatively small wear. Seventy per cent higher wheel life has been reported, due to the removal of the shoe from the tread. Still greater improvement may be found possible if full advantage is taken in the removal of the thermal limitation by arriving at the optimum analysis and hardness of the wheel tread. The brake is silent at all times and so smooth in operation that the passengers are unaware of the high deceleration rates of even emergency application because of the absence of chatter.

The coefficient of friction is substantially constant irrespective of speed, inertia load, shoe pressure, or temperature rise under prolonged applications, as occasioned on mountain grades. Accordingly maximum controllability is achieved since the brake output remains proportional to the brake-cylinder pressure. Thus for a given brake-cylinder pressure a given deceleration obtains irrespective of speed; and speed-governor control, with its added complexities, is not required.

Check Valve

A line of check valves operating on a low pressure differential and embodying no metallic operating parts to stick, slam, chatter or leak, is available in sizes ranging from ½ in. to 12 in. from the Grove Regulator Company, sixty-fifth and Hollis streets, Oakland, Calif. They were developed for handling air, gas, water and refined petroleum products at temperatures up to 180 deg. F.

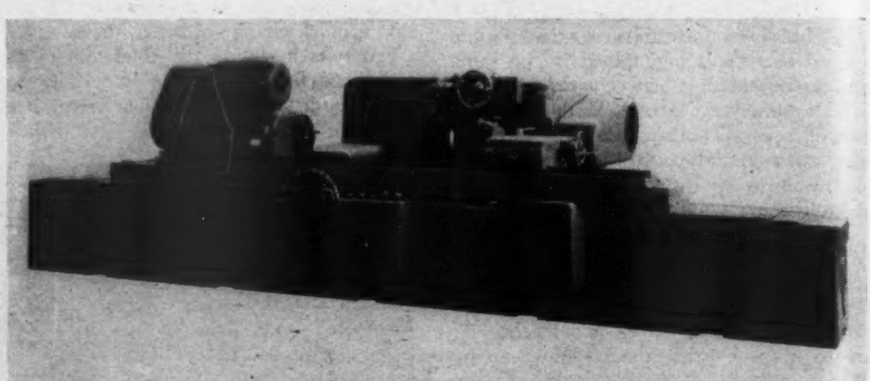


The Chexflo valve in the open and closed positions

A feature of this Chexflo valve is its flexible tubular operating member. This member comprises a thick load section which tapers down to a sensitive operating lip and is said to require no differential pressure to effect positive bubble-tight shut-off. The tapered synthetic rubber lip freely expands to open, permitting a streamline flow. Because of its resilient elasticity, it contracts to close on slack flow prior to the start of back flow. The degree to which it opens or closes is in direct ratio to flow volume. In the open and closed position it is fully supported against extreme pressure or intensive impulse shocks by the inner walls of the valve body, and by the cylindrical acorn-shaped core which it tightly encompasses. As it reaches shut-off position, flow velocity increases to flush the seating surface of any small particles.

Plain and Roll Grinder

The Landis type F grinding machine accommodates shafting, rolls or work requiring a taper. A product of the Landis Tool Company, Waynesboro, Pa., it can grind anti-friction-bearing axles and piston rods with the pistons mounted. The machine is manufactured in swings of 14, 16, 20, 24, 30 and 36 inches, and in lengths between centers ranging from 48 to 240 inches. The standard machine will accommodate 6,500 lb. between centers; heavy head and footstocks can be furnished to carry 10,000 lb. Grinding wheels 30, 36, or 42 in. in diameter may be used.


The Landis 14-in. by 96-in. Type F grinding machine

The headstock features an all-vee-belt drive. A pinion, built into the base, engages a rack on the table to move the headstock. Either a.c. or d.c. motors may be used. As extra equipment, a tachometer may be designed into the headstock to indicate work speeds. For special applications, equalizing work drivers and a brake switch on a.c. drives, to stop movement of the headstock spindle quickly, can be supplied.

The footstock, like the headstock, is secured to the swivel table by clamps which may be adjusted from the front of the unit. A geared handwheel, rotating an Acme screw, moves the spindle and center. A lever-operated screw clamp locks the spindle in grinding position. The spindle adjusting mechanism is mounted throughout on needle bearings and uses a ball-type thrust on the main spindle. A diamond bar bracket is mounted on the footstock with a means for shifting the diamond bar into position for dressing the wheel. A socket for a diamond nib is machined into the footstock base.

The sloped dovetail top of the swivel table allows the headstock and footstock to be moved in alignment without any other means of guiding. The angular table also serves as a natural drain for the coolant. A preloaded, tapered roller bearing is used as a swivel stud to eliminate shake and the ends are locked to the carriage by means of toe clamps. Swivel adjustment is obtained by the use of a screw which engages a swivel nut. A dial indicator functions with this adjusting device and aids in making settings; the complete mechanism is enclosed in a pocket with a hinged cover at the headstock end of the table.

A variable-speed hydraulic motor traverses the carriage on the type F machine. The drive is through a gear train to a pinion which engages the rack under the carriage. The rack is positioned close to the vee guide to eliminate twisting action of the carriage caused by unequal loads on vee and flat guides. The hand traverse operates through the same gear train and is engaged and dis-engaged hydraulically. On a 16-in. by 96-in. machine a 5-lb. force applied to the handwheel traverses the swivel table and carriage. One turn of the handwheel will move the work carriage .100 in.

Speed variation of the traverse ranges from 3 to 90 in. per minute. To maintain a constant rate of traverse regardless of changes in viscosity of the hydraulic oil, a compensating relief valve is used. After the speed is set a balancing valve maintains it to prevent varying loads from effecting the rate of traverse.

The hydraulic traverse mechanism is mounted on the front of the machine, and can be removed as a complete unit if servicing is necessary. Valves controlling the motor are connected by manifold to the motor so that either unit may be moved without disturbing the other.

A semi-enclosed wheel base equipped with Microsphere bearings features pressure lubrication for the spindle bearings. The lubricant is contained in a separate reservoir in the base and has its own

pump and filter. Pressure must be built up in the bearing housing before a pressure switch will close and allow the wheel drive to start. The Microsphere bearings have a special oil groove pattern, produce a thin oil film and a minimum running clearance. The spherical shape of the bearing makes it self-aligning to its housing, and the split construction allow clearance adjustments in increments of tenths.

The grinding-wheel feed is furnished in a variety of combinations. The handwheel feed reduces the work diameter .100 in. per revolution with a dial provided to secure feeds as low as .0001 in.

Electrical equipment features include totally enclosed motors, dust- and moisture-tight multi-motor panel including a disconnect switch, steel conduit and oil-proof electrical hose for flexible leads, 110-volt push-button circuits and push buttons and color-coded synthetic insulated wire that is oil and water proof. The motors and control equipment are mounted at least two feet above the floor for mechanical protection and accessibility.

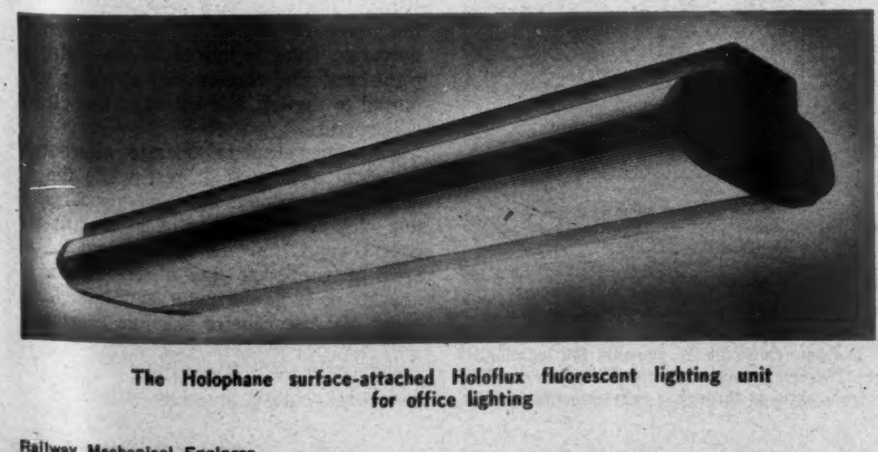
For the operator's convenience and ease of set-up, dual push-button stations are incorporated. One is at the front of the bed and the other is adjacent to the wheel-feed hand wheel.

Rolls with convex or concave shapes may be ground on this machine when equipped with the patented Landis Tool crowning device. Designed to fit the rear of the bed this mechanism may be adjusted to produce any crown desired by setting an eccentric, and selecting two of five change gears for the proper ratio. Changes required in the slide when furnishing a crowning mechanism permit larger work diameters to be ground than on a plain machine. Electric rapid feed and automatic hand-wheel feed are available when a crowning mechanism is specified.

Surface-Attached Fluorescent Fixture

A fluorescent lighting fixture for use in office and other commercial applications, which is designed primarily for mounting flush against the ceiling, is now being offered by Holophane Company, 342 Madison avenue, New York 17. It employs two or three horizontally mounted lamps. The light is distributed by a curved type Controlens which collects the light from the lamp and bends it downward in an intensive pattern to provide maximum illumination over the useful areas. This bending action eliminates glare at normal viewing angles. The luminous background for the lighting system is produced by the upper refracting section of the unit which spreads an appreciable amount of illumination across the ceiling. The fixture is 8⅜ in. deep, and is protected against the collection of dirt and dust.

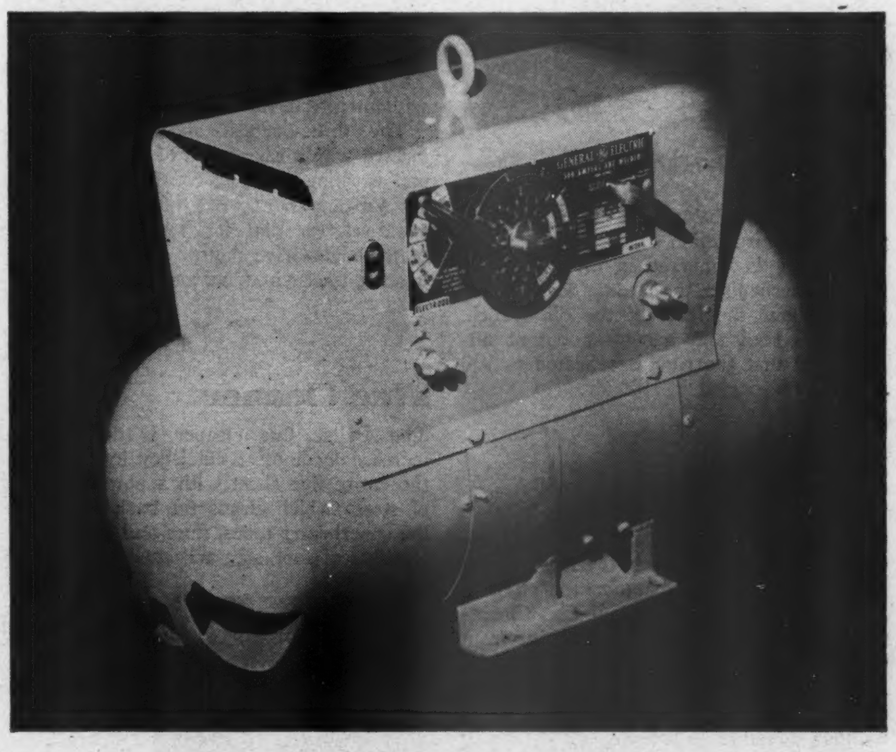
These fixtures may be installed as single units, or ganged together in extended lengths. They may be suspended on stems where room heights are extreme or where there are obstructions, such as beams or sprinkler pipes.



The Holophane surface-attached Holoflux fluorescent lighting unit for office lighting

Heavy-Duty Arc Welders

A line of heavy-duty, single-operator d-c arc welding machines, type WD-40 series, has been designed for improved welding characteristics and a 50 per cent saving in over-all size and weight by the General Electric Company, Schenectady 5, New York. Operating at 3,500 r. p. m., the welders are available in 200- 300-, and 400-ampere ratings. The arc is established and maintained with the welders by more than full arc voltage being generated instantly after short circuit, thereby largely eliminating arc pop-out.



General Electric 300-amp. d.c. arc-welding machine

A single-dial, dual control makes it possible for the operator to preset the correct current for any given job without having to make other adjustments after the arc is struck. With this current presetting arrangement, a tap switch handle in the form of a pointer is set to the electrode size being used and automatically points out the proper one of several graduated scales on the face of the current-setting dial. This indicates the current range which should be used.

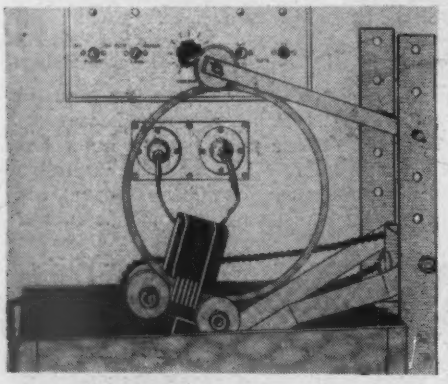
Short-circuit current peaks are adjusted to provide a stable arc and instant recovery. Voltage is said to be never less than arc voltage. To facilitate inspection and maintenance, weather-resistant end covers on both the welder and the control box can be removed with a screw driver, making the motor, generator, commutator, brushes, and controls accessible. The standard assembly includes a stationary welding generator, driving motor, control cabinet and panel, and a motor starter assembled in a single, compact unit. A two-wheeled, balanced running gear is available as an optional feature.

Induction-Hardened Piston Rings

The Ceco Ring is the trade name given by the Chambersburg Engineering Company, Chambersburg, Pa., to its piston ring which is heated by induction and automatically quenched and tempered. This manufacturing process is said to result in a piston ring with wearing qualities that extend its

useful life threefold or better, and one in which tension, hence sealing properties, is maintained througout the life of the ring.

Heat treatment is accomplished by mechanically feeding the ring through the work coil of an electronic heater which is immersed in oil. The power output of the generator and the speed of the feeding device are so regulated that the section of the ring passing through the coil is heated to 1600 deg. F. and immediately quenched as it passes from the coil into the oil quench. The temperature of the oil



Electronic heat treatment of the Ceco Ring

quench is held below the flash point by continuous circulation of the liquid.

The ring is tempered in the same continuous mechanism, the feeding device being raised above the level of the oil quench, and the speed and generator output adjusted so that the ring is reheated to 950 deg. F. and cooled in still air.

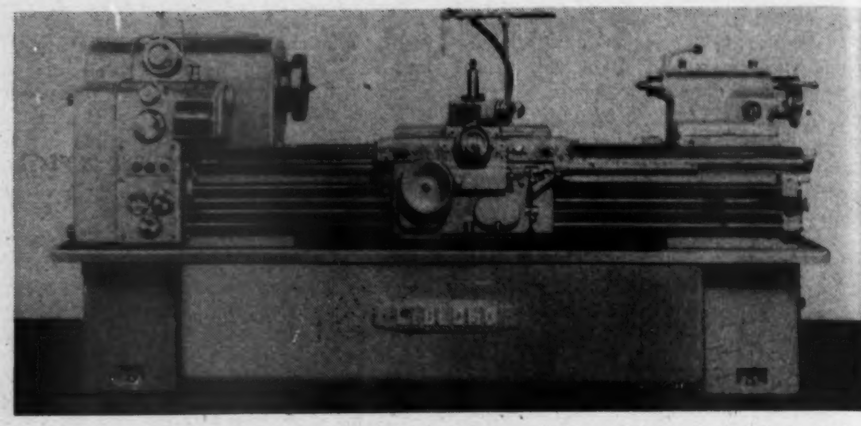
Tool Room Lathe

A wide range of spindle speeds and ease of operation are featured in the 16-in. model RT tool-room lathe manufactured by the R. K. LeBlond Machine Tool Co., Cincinnati 8, Ohio. Over 300 speeds ranging from 6 to 1,500 r. p. m. are controlled by the speed-adjuster unit. More than 100 speeds may be obtained in each of three ranges without stopping the spindle.

The model RT lathe has a universal power rapid traverse which moves the carriage, cross slide, and tailstock. The totally enclosed universal quick-change box is fitted with a revolving index plate on the feed box which contains instructions for obtaining five different types of 60 threads and leads each. There is automatic lubrication throughout the headstock, feed box and apron.

A combination gear-belt drive headstock provides the various spindle speeds in three ranges. The combined feed apron has an arrangement for connecting the length and cross feeds for cutting tapers in connection with a geared-type taper attachment. The thrust-lock tailstock with worm-and-rack construction gives full length bearing support for the spindle barrel. An L-shape bed supports the entire headstock base and is fitted with replaceable flame-hardened and ground steel-bed ways front and rear.

The variable-speed drive with which this lathe is powered consists essentially of four



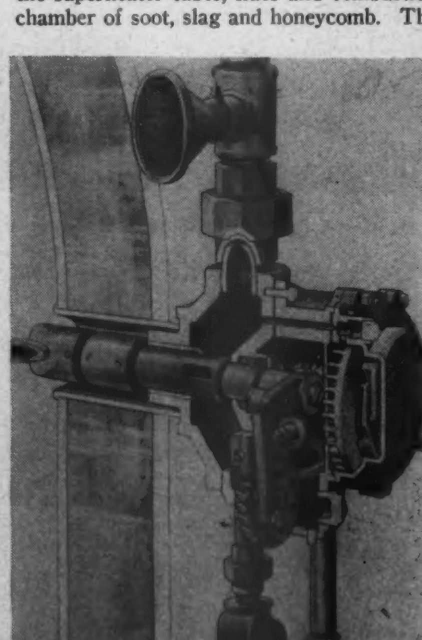
The LeBlond model RT tool-room lathe with which over 100 speeds are obtainable in each of three ranges without stopping the spindle

elements: the speed-control units, a 7½-hp. adjustable-speed main-drive motor, a speed-adjuster unit with rheostat, and a motor generator. This drive replaces brakes and clutches, provides torque with controlled acceleration for all starting conditions, and stops quickly through dynamic braking. The motor may be stopped and started without interfering with the speed setting.

The three-purpose speed-adjuster unit, located within easy reach of operator's normal working position, consists of a shifter for shifting to any one of three drives, a speed-selector dial for varying the speed of the main-drive motor, and a button for jogging the main-drive motor.

Flue Cleaner

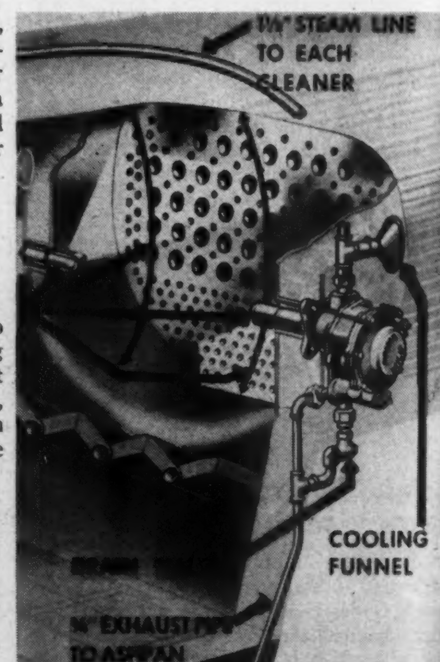
The Prime flue cleaner is designed to increase locomotive efficiency by sweeping the entire flue sheet with a powerful blast of steam which cleans the back flue sheet, the superheater tubes, flues and combustion chamber of soot, slag and honeycomb. The



The Prime flue cleaner, showing the location of the cleaner in regard to the boiler sheet—The nozzle extends through a tube into the fire box

cleaner makes it unnecessary to kill fires and to take the locomotive out of service between boiler wash periods for the purpose of cleaning flues.

The necessary equipment consists of two blowers, one mounted on each side of the fire box, a pneumatically operated duplex steam valve, and a rotary-type operating



The sweeps of the right and left flue cleaners overlap in the middle of the flue sheet to give additional cleaning action where the heaviest accumulation of soot, slag and honeycomb occurs

valve. The operating valve is located on the fireman's side of the cab. When the operating lever is moved to the right, the right-hand flue cleaner will operate; when moved to the left, the left-hand flue cleaner will operate.

The flue cleaners operate alternately; the right cleaner is at rest while the left cleaner is working, and vice-versa. Each flue cleaner sweeps steam in an arc that covers approximately 60 per cent of the area of the back flue sheet. Thus the nozzles of both the right and left cleaner cover 100 per cent of the flue sheet area, and overlap in the central area of the sheet where the accumulation of soot, slag and honeycomb is the most serious.

The fireman operates the flue cleaner at the start and finish of each run. He also operates it every 30 minutes during the run, when the fire is knocked or cleaned, and at every stop during the run.

According to the manufacturer, The Prime Manufacturing Co., 1669 South First street, Milwaukee 4, Wis., the flue cleaners should be operated for a minimum of two minutes when they are used for the most efficient service.

Railroad Toilet Unit

The Combolet is a railroad toilet unit for individual accommodations made by the Dayton Manufacturing Company, Dayton, Ohio, that takes up less than a square foot when recessed in the wall and only two square feet of floor otherwise. It combines a washbowl with a jet-flushing water closet which flushes on about one-ninth the water needed by conventional siphon-jet units.

In the Combolet everything folds up. A button is pushed to lower the toilet hopper. A retractable flush lever swings out of the base. Pushing a second button causes both to disappear back into position. To avoid tugging and pulling, operations are performed by two hydraulic cylinders. A squeeze on a finger latch releases the washbowl. The basin has its drain at the back, and is emptied by tipping it shut. A special screen is included in the drain for retrieving forgotten items.

The wash basin, hopper, and all other sheet-metal parts are made of Monel, which is rust-proof and solid all the way through. There are only one electrical and three plumbing connections to make, and it requires no special strength members in the supporting walls. With hopper and washbowl closed, the model M47 is 78⅞ in. high by 16⅝ in. wide by 14⅛ in. deep and weighs 135 lb. Special features include horizontal fluorescent lights, used razor blade receptacle and electrical outlet for dry shavers. Other Combolet models are the M46, without mirror and lights, and the M48, which has a folding washbowl with fixed hopper.

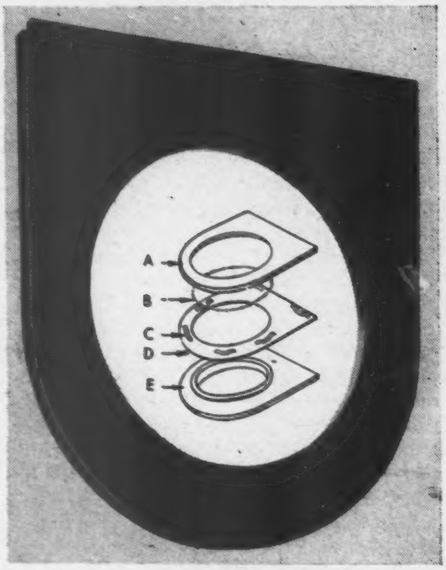
The Combolet railroad toilet

Expanding Dust Guards

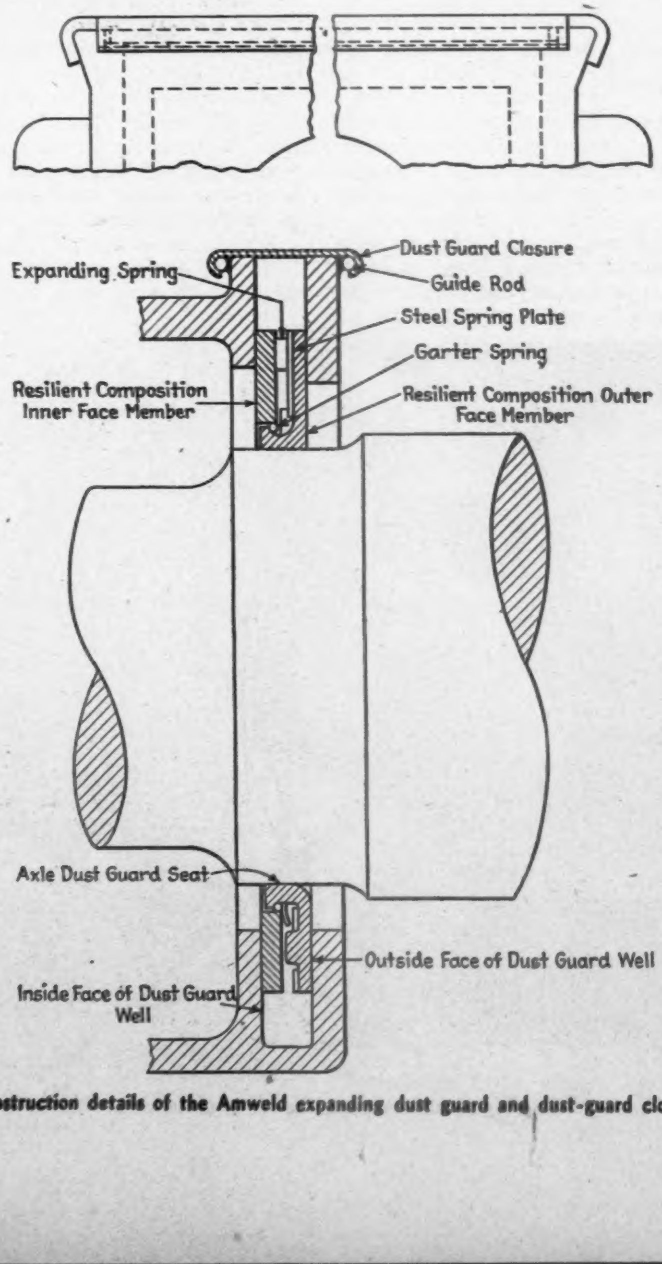
Amweld dust guards are designed to exclude dust and moisture, and to conserve lubricant by their oil-retaining action. The guard has four component parts,—two synthetic composition face plates, a steel spring plate, and a garter spring.

In operation a two-way seal is provided. The spring plate maintains pressure against both face plates, which in turn bear against the front and back faces of the dust guard well. For sealing against the axle, the plastic characteristic of the resilient face member compound is utilized. At operating temperatures, the J-shaped axle-sealing lip becomes plastic and provides a seal due to the tendency of the lip to align itself with the main body. At all other times the garter spring assures a positive seal.

Further protection against the entry of foreign matter can be obtained by Amweld dust guard closures. These simple sheet-metal stampings have projecting ends which may be clamped down over closure lugs or straight sidewalls of the dust guard well. Amweld expanding dust guards and dust-guard closures are available from the American Welding & Manufacturing Company, Warren, Ohio.



Amweld expanding dust guard with insert showing: *A*, inner face member; *B*, garter spring; *C*, expansion spring; *D*, steel spring plate, and *E*, outer face member



Construction details of the Amweld expanding dust guard and dust-guard closure

Baking Varnish

A moderately priced, Bakelite-base all-purpose insulating varnish for use on all types of wound coils has been announced by John C. Dolph Company, Department 16, 1060 Broad street, Newark 2, N. J. Known at Synthite AJR-7, the varnish is said to cure rapidly and completely at temperatures lower than those required for most varnishes of a similar type. It is adapted for use on all modern types of coated magnet wire such as Formvar, Formex, nylon and glass, providing a build-up heavier than that afforded by many previously formulated thermo-setting varnishes.

The varnish can be applied by either atmospheric dip or vacuum impregnation, and is said to produce excellent results whether baked under infra-red or in conventional gas or electric ovens. It has a high degree of dip-tank stability and is easily handled in both production and repair-shop treating cycles. It may be obtained in all standard containers from one-gallon cans to fifty-five-gallon drums.

Locomotive Fire-off

A portable unit for lighting the locomotive fire has been developed by Mahr Manufacturing Company, Minneapolis, Minn. When using this device the fireman throws his coal onto the grate, levels it off, and applies the flame with the Mahr locomotive fireoff. The wet flame spreads over a wide area and impregnates the coal with hot oil. This device is said to permit the operator to start the fire in the locomotive with minimum of smoke in the enginehouse.

The torch itself is made from a single piece of pipe of sufficient length to reach easily every corner of the firebox. The nozzle supplies a hot, wet flame which is directed downward. There is no air pressure on the tank. The oil which is in the tank is drawn to the burner from the tank by a vacuum created by compressed air, reducing the possibility of an exploding tank or a bursting oil hose.

This locomotive fire-off is equipped with an automatic air cut-off lever which is held down continually by the operator's finger while the torch is in use. When this automatic air cut-off lever is released for any reason the flame is automatically extinguished. There is also a plug valve that trips on the rim of the firebox door, preventing oil left in the pipe from running out after the air is cut off. When the torch is removed from the firebox, the oil in the line flows back to the tank.

The tank capacity is 20 gallons, and kerosene distillate or low-grade fuel oil may be used. Each unit is designed to operate on compressed air at 80- to 100-lb. pressure. A steam coil is included in the tank to preheat oil in cold weather.

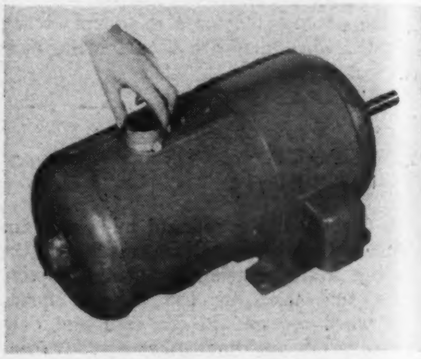
The Mahr locomotive fire-off in operation

Motors with Stepless Speed Adjustment

A line of Tri-Clad brush-shifting adjustable-speed induction motors, (type ACA), has been announced by the motor divisions of the General Electric Company. Available in ratings from 3 to 50 hp. (220, 440, and 550 volts), the new motor features stepless speed adjustment over a 3:1 ratio by simply turning a dial. The entire unit, with the exception of the starter control, is self-contained in a housing only a little larger than that for a constant-speed motor of comparable rating.

Remote speed control can be accomplished by the use of a flexible cable shaft up to 10 ft. away from the motor. For complete remote control, a small pilot motor can be used to drive the speed-control mechanism.

Uniform cooling with low intake velocity is accomplished by double-end ventilation. Necessary over-load protection and limit switches to insure proper starting are built into the motor. The standard frames (225 to 505) have N.E.M.A. mounting dimensions. For resistance to oil and heat aging, Formex wire stator windings are used. A cast-iron bearing enclosure affords protection from moisture, dust, and dirt.



A three-to-one speed control is incorporated in the motor itself

The motor is rated on a constant torque basis. It will carry full-load torque at rated current and frequency without exceeding a temperature rise of 40 deg. C. on high speed, or 50 deg. C. on low speed, measured by a thermometer on the windings. The power factor is high when the motor is running at high speed. At synchronous speed, it is about the same as with a squirrel-cage induction motor of similar rating.

For intermittent use, speeds below minimum rated may be obtained by adding secondary resistance. Plugging is possible by the same means. The motor is reversible for short periods of time, by reversing two power leads.

Convenient inspection plates may be removed for inspection of brushes and the brush-shifting mechanism. The motor may be greased while in operation. All necessary inspections may be performed without removing any operating parts.

G. N. Box Cars "Light Up" at Crossings During Darkness.—In the interest of night-time safety at grade crossings, the Great Northern is coating 500 box cars with "Scotchlite" reflective sheeting which, when caught in the beams of auto headlights, causes the lettering on the sides of the cars and the road's goat emblem painted there to reflect a brilliant caution hundreds of feet away. As an additional precaution, eight diamond-shaped delineators are evenly spaced the entire length, and at the lower edge, of each car.

"Scotchlite" is weatherproof, can be cut to any design and reflects in 14 different colors, according to its producers, the Minnesota Mining & Manufacturing Co. The material is claimed to be 150 times brighter at night than white paint.

NEWS

Lincoln Foundation Announces Railroad Welding Awards

AWARDS ranging from $100 for honorable mention to $13,500 for the main prize have been announced in the James F. Lincoln Arc Welding Foundations $200,000 Design-For-Progress Program. The winner of the $3,200 first prize in the program's railroad classification is Leonard Pompa, development engineer, Lukenweld, Inc., Coatesville, Pa. His prize winning paper describes the re-design and fabrication of arc welded underframes and side trusses for a 2,000-hp. Diesel-electric locomotive. The objective was to obtain a minimum reduction in weight of 20 per cent. Mr. Pompa's new design resulted in an underframe weighing 12,000 lb. less.

Robert H. Macy, chief, Locomotive Division, Ingalls Shipbuilding Corp., Pascagoula, Miss., won the second prize of $2,000 in the railroad classification for his discussion of improved welding practices that saved 4,906 lb. in weight and $3,955 in cost of a Diesel-electric locomotive.

Three engineers of the Pullman-Standard Car Manufacturing Company, Chicago, won the third and fourth prizes. J. E. Candlin, assistant to chief engineer, and C. G. Delo, Jr., design engineer, were coauthors of the $1,700 third prize with their description of box-car production at reduced cost by arc welding.

Arthur M. Unger, chief welding engineer, was awarded the $1,200 fourth prize for his study and redesign of a passenger car to improve the welding procedures, reduce the costs and increase the production.

Another Pullman-Standard man, C. H. Blaine, welding engineer and assistant superintendent, Butler, Pa., won the $1,500 third prize in the industry-machinery classification for his paper describing the use of welded jigs and fixtures in the manufacture of freight cars.

Orders and Inquiries for New Equipment Placed Since the Closing of the November Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Denver & Rio Grande Western	4[1]	1,000-hp. Diesel-elec. switch	Fairbanks-Morse
	3[1]	1,500-hp. Diesel-elec. switch	Fairbanks-Morse
Lehigh & New England	10[2]	1,500-hp. Diesel-elec. frt.	American Loco.
	1[2]	1,000-hp. Diesel-elec. switch	American Loco.
Lehigh Valley	7[3]	2-unit 4,000-hp. Diesel-elec. pass.	American Loco.
Norfolk & Western	10[4]	2-8-8-2 frt.	Company shops
Union Pacific	5[5]	2,000-hp. Diesel-elec.	Fairbanks-Morse
	12[6]	1,500-hp. Diesel-elec. pass.	Electro-Motive
	80[6]	1,500-hp. Diesel-elec. frt.	Electro-Motive
Western Maryland	2[7]	1,500-hp. Diesel-elec.	Electro-Motive

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Atchison, Topeka & Santa Fe	750	70-ton gondola	American Car & Fdry.
	250	70-ton ballast	American Car & Fdry.
	200	70-ton hopper	American Car & Fdry.
	250	16,000-gal. tank	General American
	200	70-ton covered hopper	General American
	100	50-ton gondola	Pressed Steel
	300	50-ton hopper	Pullman-Standard
Chicago Great Western	10[8]	70-ton gondola	Pressed Steel
Chicago, Indianapolis & Louisville	100[9]	50-ton box	Pressed Steel
Denver & Rio Grande Western	15[10]	50-ton tank	General American
Kansas City Southern	500[11]	70-ton gondola	Pullman-Standard
New York Central System	2,000	55-ton hopper	Despatch shops
	1,000[12]	70-ton hopper	Greenville Steel Car
Virginian	500	50-ton gondola	Company shops
	500	50-ton hopper	Company shops

FREIGHT-CAR INQUIRIES

Road	No. of cars	Type of car	Builder
Baltimore & Ohio	2,000	70-ton hopper	Budd Co.

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
Wabash	6[12]		Budd Co.

[1] Smaller locomotives will cost approximately $360,000; the larger, $375,000.

[2] These locomotives, for delivery around mid 1948, will be used to Dieselize completely L. & N. E. main line service between Pen Argyl, Pa., and Maybrook, N. Y., and to Dieselize partially the service west of Pen Argyl.

[3] For service between New York and Buffalo, N. Y. Delivery expected early in 1948.

[4] These locomotives will be of the Y6a class, similar to the 16 built at the Roanoke shops in 1942 and 1943, and will cost about $2,000,000. They will have solid cast-steel frames and roller bearings on all wheels. First of the new locomotives will be ready for service about four months after construction begins and they will be delivered thereafter at the rate of one a month.

[5] Delivery expected by the end of the year. Estimated cost $870,000.

[6] Deliveries expected to start in April, 1948 and to be completed in October 1948. Approximate cost $14,000,000.

[7] Delivery expected in August, 1948.

[8] Delivery scheduled for April, 1948.

[9] Fifty standard type, 50 with perforated linings. Delivery scheduled for first quarter 1948.

[10] Delivery scheduled for second quarter 1948.

[11] Delivery expected to begin in July, 1948.

[12] For the Pittsburgh & Lake Erie.

[13] For a stainless-steel train, the consist of which is yet to be decided. For service between Chicago & St. Louis.

NOTES:—

Chesapeake & Ohio.—The C. & O. has authorized the purchase of 45 steam locomotives and 200 automobile cars at an estimated cost of $10,900,000. Fifteen of the locomotives will be of the 2-6-6-6 type with tractive force of 100,000 lb., and the remaining thirty will be heavy duty switching engines.

Great Northern.—The Great Northern will spend $7,600,000 for new freight cars and for new rail and necessary fastenings. The railroad's board of directors on October 23 approved the construction of 500 steel-sheathed box cars to be built in the G. N.'s shops at St. Cloud, Minn., and Superior, Wis., and authorized the purchase of 200 gondolas, 75 covered hopper cars, four lightweight steel baggage cars and 50,000 tons of new rail, plus fastenings. Mr. Gavin said. The G. N. completed construction, early in October, of 500 box cars in its own shops and is awaiting delivery of materials to begin work on an additional 500 cars, the construction of which was authorized several months ago.

New York, New Haven & Hartford.—The New Haven will spend $6,000,000 to purchase 46 new passenger cars and recondition and modernize 104 old cars if the road's applications for fare increases pending in four states, are granted.

Missouri-Kansas-Texas.—In an attempt to remedy the shortage of gondola cars a car-building program has been set up in the Katy car shops in Denison, Tex., and deliveries are expected to begin about the first of the year. The cars will come off the line at a rate of about four a day. The road is also shopping 100 flat cars, putting board sidings on them, and re-equipping them as gondolas to help relieve the shortage.

Union Pacific.—The board of directors of the Union Pacific has approved a $67,000,000 improvement program, to include the purchase of new rolling stock (passenger, freight, and refrigerator cars, and Diesel locomotives), and the building of a new freight classification yard. G. F. Ashby, president of the U. P., said the new expenditures would be in addition to the $100 million already authorized for the U. P.'s "long-range postwar rebuilding program."

N. P. Turns Out First Box Car at New Brainerd Shops

ON October 28, the first of 1,000 steel box cars rolled off the assembly line of the Northern Pacific's new $1,800,000 shops at Brainerd, Minn.

Since completion of the shops in 1946, the lack of materials has heretofore limited work to the repairing and rebuilding of cars. The railroad is now producing eight cars a day at Brainerd and plans to complete construction of the 1,000 cars at the shops by April 1, 1948, at an estimated cost of $4,000,000. The shops, measuring 180 ft. by 800 ft., have concrete foundations and floorings, heavy structural steel framing and walls of brick and glass block. There are four main lines and two service tracks. Three tracks allotted to construction permit work on 24 cars at a time.

* * *

Pennsylvania "Trail Blazer" coach built by A.C.F.

Supply Trade Notes

General Electric Company.—The General Electric Company has announced five staff appointments in its locomotive and

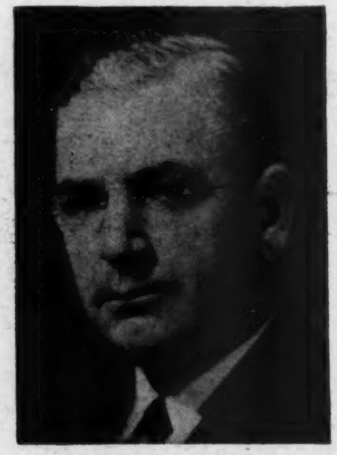
H. W. Gouldthorpe

car equipment divisions of the apparatus department at Erie, Pa., as follows: *F. H. Craton,* former assistant manager of the transportation division, to manager of sales; *H. W. Gouldthorpe,* former Erie works engineer, to manager of engineering; *David Blair,* former production manager of the Erie works, to production manager of the locomotive and car equipment divisions; *H. O. Trumpfheller,* former assistant to the manager of apparatus manufacturing at Erie, to assistant to manager—manufacturing; and *D. A. Smith,* former assistant works accountant, to accountant.

F. H. Craton joined General Electric in 1924 as a member of the factory management course in Schenectady, N. Y. From 1926 to 1930 he was a member of the railway equipment engineering division and in the latter year was transferred to the transportation engineering division. In 1941 he was appointed manager of the industrial haulage division. During the recent war he served on the industry advisory committee of builders of small locomotives of the War Production Board and also was assistant chief of the motive power section of the W. P. B.

F. H. Craton

H. W. Gouldthorpe joined the company in 1927. He worked in the motor division of the transportation engineering division and, in 1936, was appointed mechanical design section head of the division. He was assigned to the general engineering division in 1941 and in the following year was appointed executive assistant to the engineer of the locomotive engineering division. He joined the transportation division in 1944.

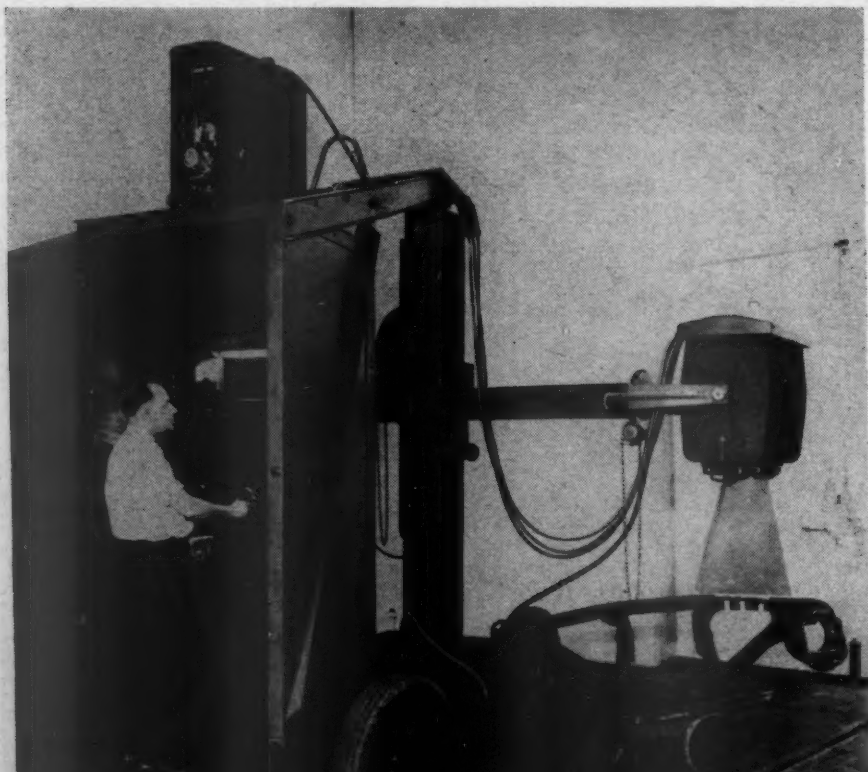


David Blair

David Blair joined General Electric in 1916 and worked on production in the locomotive division. He later assisted in organizing a supply section in the production division and served as supervisor until 1930. In that year he joined the motor

H. O. Trumpfheller

* * *



The 250,000-volt mobile X-ray machine at the Pennsylvania X-ray laboratory at Altoona, Pa., making a radiograph of a freight-car truck side frame

Nobody feels tough at Christmas time. Least of all the fellow we call the Tough Guy. He—and all of us here at the Association of Manufacturers of Chilled Car Wheels—wish you a very Merry Christmas and a Happy New Year.

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

[illegible] NORTH SACRAMENTO BOULEVARD, CHICAGO [illegible]

[illegible] Car & Foundry Co. • Canadian Car & Foundry [illegible] • [illegible] Wheel Co.

[illegible] Car Wheel & Foundry Co. • Maryland Car Wheel [illegible] • [illegible] Car Wheel Co.

[illegible]-Standard Car Mfg. Co. • Southern [illegible]

division and served successively as section supervisor, supervisor of production of the railway and industrial motor division, and assistant superintendent of the motor division, holding the latter position from 1934 to 1942, when he was appointed works production manager.

H. O. Trumpfheller entered the employ of the Erie works in 1914 as a toolmaker. In 1917 he was transferred to the motor division as an assistant general foreman of a munitions job in World War I, and later was appointed foreman of the commutator operation. When the transportation division was moved to the Erie Works in 1926, he was appointed assistant superintendent of the motor division. A short time later, he was appointed superintendent of the generator division and, in 1928, when the motor division was reorganized, he was appointed its superintendent, and later assistant to the works manager.

JOHNS-MANVILLE CORPORATION.—Johns-Manville Corporation on October 16 unveiled, near Manville, N. J., the first building in what eventually will become an extensive research center for the development of new products and the application of asbestos, magnesia, and asphalt to meet new needs. The new building is 572 ft. long and has two stories. Known as the "wet semiworks building," because all research and development involving wet processes will be under its roof, it houses a combination of ten research laboratories and pilot plants for experimental work on transite pipe, asbestos shingles, asbestos fibres, asbestos-cement board, wood-pulp board, asbestos papers, magnesia, fillers and filter aids, and asphalt products. The building is divided lengthwise in half. One half is a two-story research laboratory with a glass-enclosed promenade running the entire length of each floor. The other half is a typical three-bay factory building in which pilot-plant machinery needed for the development of new manufactured products occupies the space directly across the corridor from the laboratory in which the research involved in the development of the product is being conducted. The partitions, while not movable, may readily be taken down and re-erected when new projects call for a rearrangement of laboratory floor space. The building is air conditioned and is fitted with hung metal accoustical ceilings.

The organization at the research center is composed of about 420 people who are about equally divided between technical graduates, non-graduate assistants, and the supporting staff.

The center has been laid out to provide for extensive future expansion. Present plans call for construction of about half the space which can eventually be made available. In addition to the present building, there will be another product-development building; a research and administration building, now under construction; a machine shop, and an engineering building.

A feature of the day's ceremonies was the laying of the cornerstone of the research and administration building. Laboratories will be provided in this building for research not associated with pilot plants.

MINNEAPOLIS-HONEYWELL REGULATOR COMPANY.—*V. Dale Wissmiller* has been appointed western manager of the railway controls division of the Minneapolis-Honeywell Company, with headquarters at Chicago, and *Frank B. Conlon* has been appointed to the position of eastern manager of the division at New York.

V. Dale Wissmiller was born at Cooksville, Ill., and was graduated from the University of Illinois with an engineering degree in 1930. He was employed as a highway engineer for the Illinois State

V. Dale Wissmiller

Highway Department for six years prior to joining Honeywell in its service and installation department at Chicago. He later became service and installation manager at St. Louis, Mo., and was subsequently transferred to the firm's air conditioning controls division at Minneapolis as a sales engineer. He has been employed in the railway division at Chicago since 1944.

Frank B. Conlon was graduated as an electrical engineer from Ohio State University in 1929, after which he became a draftsman in the office of the electrical engineer of the Pennsylvania. In 1936, he joined the Sheffler-Gross Company, makers of pressure and temperature controls, as a sales engineer. His next position was with the Airtemp division of the Chrysler Corporation, where he assisted in the development of that firm's railroad air conditioning system. He became sales engineer in the transportation controls division of the Fulton-Sylphon Company in 1939, specializing in railroad controls. Following duty in the navy as a lieutenant commander during

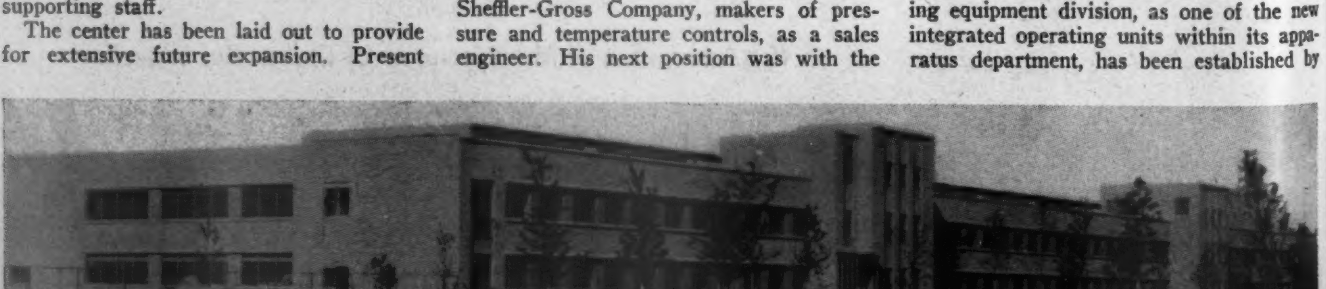
Frank B. Conlon

World War II, Mr. Conlon rejoined Fulton-Sylphon and Honeywell in September.

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—For "outstanding fidelity and meritorious conduct in aid of the war effort," *Charles A. Liddle*, chairman of the board, and *David A. Crawford*, president of Pullman-Standard, were recently awarded the Presidential Citation of Merit at Chicago. The presentations were made by Maj. Gen. Edwin P. Parker, Jr., deputy commanding general of the Fifth Army. Mr. Liddle was cited for "outstanding services during the war in the creation of productive facilities," and Mr. Crawford was honored for his "outstanding wartime services, in connection with sleeping-car facilities."

AIR REDUCTION SALES COMPANY.—*Harold H. Reed*, formerly assistant manager of the New York district of the Air Reduction Sales Company, has been appointed manager of the district to succeed *W. S. Schoenthaler*, who has retired after 37 years of continuous service with the firm. *Oren M. Donohue*, formerly assistant sales manager, has been appointed assistant district manager, succeeding Mr. Reed, and *William B. Brower* succeeds Mr. Donohue.

GENERAL ELECTRIC COMPANY.—A welding equipment division, as one of the new integrated operating units within its apparatus department, has been established by



First laboratory and pilot-plant building of a Johns-Manville research center at Manville, N. J.

the General Electric Company. The unit will be directed by a welding equipment committee headed by *A. F. Vinson*, assistant production manager of the apparatus department.

◆

PERMUTIT COMPANY.—The Permutit Company has announced the appointment of *Austin F. McCormack* as sales engineer in charge of its newly established Rochester, N. Y., office. This office replaces the one formerly located in Syracuse, N. Y., and directed by *F. D. West*, who has retired after 29 years' service.

◆

ELECTRO-MOTIVE DIVISION GENERAL MOTORS CORPORATION.—Dedication of a Locomotive Development Center, to house all personnel and facilities for future development work on General Motors locomotives —whether Diesel or some other prime mover—and an elaborate "silver anniversary" dinner featured the twenty-fifth anniversary celebration of the Electro-Motive Division of General Motors Corporation, at La Grange, Ill., and Chicago, respectively, on October 24. The Diesel locomotive as seen by the manufacturer, the inventor and the customer in their respective roles was the theme of the speeches at the dinner at the Palmer House.

In connection with the ceremonies there was unveiled a life-size bas-relief in bronze of H. L. Hamilton, an early developer of the electric drive and internal combustion engine combination as applied to rail vehicles, founder of Electro-Motive, and now a vice-president of General Motors.

The new Locomotive Development Center is a two-story building, 389 ft. by 147 ft., located east of the Administration building at the La Grange plant. In it will be concentrated all of the personnel and facilities for future development work on General Motors locomotives, whether the power be Diesel or ultimately some other prime mover. The building includes a bay in which an entire experimental locomotive can be put together, tested, or torn down. While some departments of the center are in operation, it is expected that others may not be completed and fully equipped for perhaps another year or two.

The Power Plant Group in the new Center will have five cells for running all types of tests, three of these cells being used for durability testing of all engine parts. The Transmission Group, responsible for the main generator and traction motor designs, will have an adequate setup for testing both generators and traction motors. The high bay will be used for stressing basic car body structure, trucks, and other parts of the locomotive requiring great forces. The Equipment Group will have facilities for testing fan and traction-motor blower characteristics, train heating boilers, and many smaller items.

The Air Brake Group will have facilities for checking and improving air-brake functions as well as developing more efficient ways of removing oil and water from the air-brake system. The Electrical Control Group will have space available on the balcony to develop not only experimental control schemes but to run life tests on all of the various electrical control equipment necessary in a Diesel locomotive. The Sales Engineering, Service Engineering and Styling groups are located on the second floor.

A complete metallurgical and chemical laboratory is located on the first floor with modern facilities for fatigue testing, physical tests, X-ray and many other tests required to evaluate all of the various materials used on a locomotive. This department also is responsible for maintaining and improving the quality of all production material as well as developing new and better welding methods. In this section also is located the fuel and lubricating-oil laboratory.

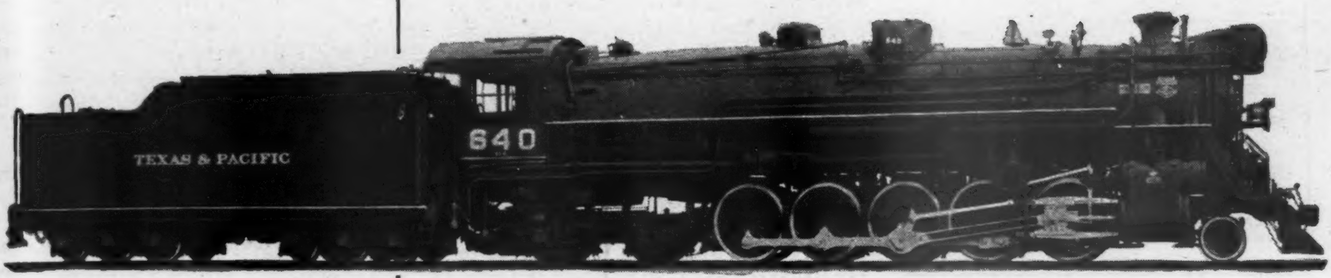
The Fuel Section works closely with the Engine Group on combustion study, and also with the petroleum industry.

There are also facilities for the develop-

Right: Bas-relief by Paul Manship in honor of H. L. Hamilton unveiled at LaGrange, Ill.

Below: The Locomotive Development Center of the Electro-Motive Division, General Motors Corporation, at LaGrange

NEW BOOSTERS* FOR OLD



AUTOMATIC COMPENSATORS AND SNUBBERS are also being installed in connection with the equipping of these ten locomotives with roller-bearing rods and boxes. This Franklin equipment, applicable to either surface- or roller-bearing boxes, prevents slack, cushions abnormal shocks, and protects closely fitting parts.

TEXAS & PACIFIC

replaces old Boosters with latest type in complete modernization of 10 locomotives*

In connection with its program of completely modernizing ten 2-10-4 locomotives, Texas and Pacific Railway is replacing 1926-built C-2 Boosters with the latest E-1 type.

The old Boosters earned their retirement by giving 20 years of good service. With the new Boosters, Texas and Pacific will have more initial drawbar pull (15,000 pounds at start), improved efficiency, reduced maintenance, and a Booster that can be cut in at higher speeds, worked up to 30 mph.

**Trade Mark Reg. U. S. Pat. Off.*

REG. U.S. PAT. OFF.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO • MONTREAL

STEAM DISTRIBUTION SYSTEM • BOOSTER • RADIAL BUFFER • COMPENSATOR AND SNUBBER • POWER REVERSE GEARS AUTOMATIC FIRE DOORS • DRIVING BOX LUBRICATORS • STEAM GRATE SHAKERS • FLEXIBLE JOINTS • CAR CONNECTION

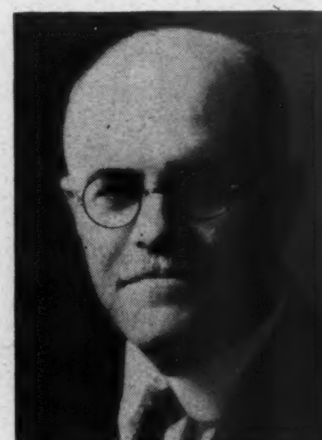
ment of all types of electronic equipment needed for various tests, and facilities for building all types of equipment which may be necessary for investigation of any problem, either experimentally in the plant or on the locomotive in the field. This group works closely with General Motors Research and other testing laboratories.

◆

Westinghouse Air Brake Company; Union Switch & Signal Co.—*Gwilym A. Price,* president of the Westinghouse Electric Corporation, has been elected a director of the Westinghouse Air Brake Company and the Union Switch Signal Co. Mr. Price fills a vacancy on the board caused by the resignation of *A. W. Robertson.*

◆

American Locomotive Company.—*Horace C. Pentecost,* whose retirement as elevation engineer of the American Locomotive Company on July 1 was announced in the November issue, started his career in the car department of the Northern Pacific.



H. C. Pentecost

In 1899 he became associated with the engineering department of the Brooks Locomotive Works at Dunkirk, N. Y., and in 1907 was transferred to the Schenectady plant of the American Locomotive Company as elevation engineer. During these 40 years Mr. Pentecost had been in active charge of engineering details involved in the building of steam locomotives for the New York Central.

The main office of the American Locomotive Company is gradually being transferred from New York to Schenectady, N. Y. *George Mason,* director of information, is now located at Schenectady, and the transfer of Public Relations Department to that city is expected to be completed on or about April 15, 1948.

◆

Railway Mechanical Engineer.—*G. J. Weihofen,* who has been a member of the mechanical department editorial staff of the *Railway Mechanical Engineer* in its New York office since April, 1946, will after November 2 be located in the Chicago office, as associate editor, *Railway Mechanical Engineer and* Railway Age. Adequate coverage of railway mechanical developments in a territory covering more than half of the United States is beyond the capacity of a single individual, and Mr.

HOUSTON BELT & TERMINAL

1 600 H.P. General Motors Diesel switcher, operating from March 1940 to June 30, 1947, has worked a total of 63,860 hours, an average of

726 HOURS PER MONTH

AVERAGE AVAILABILITY — 97.0%

ATLANTIC COAST LINE

6 1000 H.P. General Motors Diesel switchers, from January 1940 through June 30, 1947, worked a total of 258,677 hours. This is an average of —

674 HOURS PER MONTH

AVERAGE AVAILABILITY — 93.1%

CHICAGO & EASTERN ILLINOIS

7 600 H.P. General Motors Diesel switchers, in operation from January 1942 through April 30, 1947, worked a total of 334,851 hours. During this period these locomotives averaged —

634 HOURS PER MONTH

AVERAGE AVAILABILITY — 94.6%

CHICAGO, ROCK ISLAND & PACIFIC

44 General Motors Diesel switchers (600 and 900 H.P.) during the ten-year period from May 1937 to June 30, 1947, totaled 2,923,342 hours. They attained an average per locomotive of —

642 HOURS PER MONTH

AVERAGE AVAILABILITY — 95.3%

Weihofen, under the direction of E. L. Woodward, western editor, will now share in the cultivation of that territory.

◆

WESTINGHOUSE ELECTRIC CORPORATION.—*John E. Payne,* formerly manager of industrial sales, has been appointed manager of all industry sales departments for the Westinghouse Electric Corporation, and *R. S. Kersh,* manager of the Houston, Tex., office since 1942, has been appointed manager of industrial sales, to succeed Mr. Payne. Both will have headquarters at East Pittsburgh, Pa.

◆

INDEPENDENT PNEUMATIC TOOL COMPANY.—B. H. Johns, manager of the St. Louis (Mo.) branch of the Independent Pneumatic Tool Company, has been appointed manager of the company's mining and contractors tool sales division, with headquarters at Chicago. Mr. Johns will be succeeded by *W. B. Smith,* manager of the firm's Houston (Tex.) office, who, in turn, is succeeded by *R. F. Caslin.*

◆

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—*Norman B. Johnson,* manager of freight-car plants of the Pullman Standard Car Manufacturing Company, has

Norman B. Johnson

been appointed to the newly created post of assistant executive vice-president, with headquarters at Chicago. Mr. Johnson's portrait appears here. That used with the sketch of his career on page 669 of the November issue was incorrect.

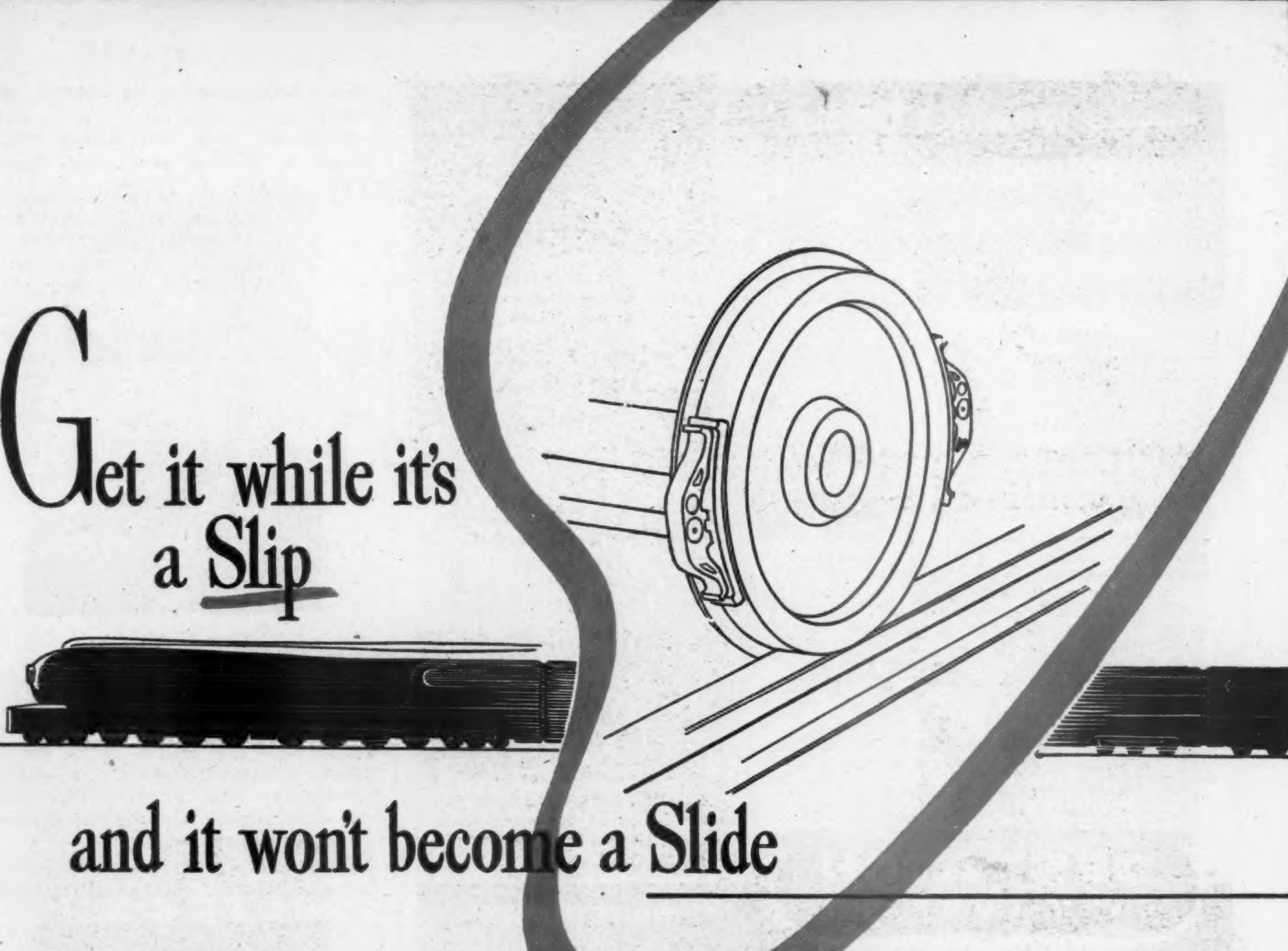
◆

MORRISON RAILWAY SUPPLY CORPORATION; MORRISON METALWELD PROCESS, INC. —The Morrison Railway Supply Corporation and its subsidiary, Morrison Metalweld Process, Inc., have established offices in the Empire building, Birmingham, Ala. *Marvin B. Morrison,* vice-president and southern division manager, will be in charge of the new office.

◆

ST. LOUIS RAILWAY SUPPLY COMPANY.—*Frank E. Ross, Jr.,* and *Robert M. Close* have announctd the formation of a partnership to be known as the St. Louis Railway Supply Company, with an office at 2114 North Second street, St. Louis, Mo. Mr. Close operates the Aquart Manufacturing Company, which company the partners will represent in addition to acting as manufac-

Get it while it's a Slip



and it won't become a Slide

The Westinghouse "AP" Mechanical Decelostat does just that when a wheel starts to slip during brake application. The instant that a wheel begins to lose rail adhesion, this constant guardian detects it and momentarily relieves brake pressure on that particular wheel. Thus, the wheel is kept turning and doing its best job of effective retardation under existing conditions.

The "AP" Decelostat becomes even more important with today's higher train speeds, closer schedules, and increased braking forces required to control trains safely. Here, wheel slip detection is doubly imperative, because a slip which develops into a slide means *that* wheel is not doing its best job of retardation. "AP" Decelostat will detect that "slip" and keep the wheel rolling—assuring efficient braking.

To meet the requirements of shorter schedules and higher train speeds, specify these Westinghouse running mates:

"HSC" Electro-Pneumatic Brakes . . . for braking flexibility to match modern train speeds, and unequalled smooth action.

Speed Governor Control . . . for regulating brake forces to wheel speeds.

"AP" Mechanical Decelostat . . . for wheel slip detection to keep the wheels rolling.

Westinghouse Air Brake Co.

WILMERDING, PA.

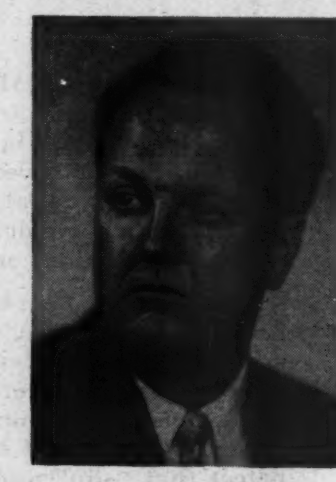
turers' representative for several other firms.

Frank E. Ross, Jr., entered railroad service in 1936 with the Terminal Railroad

Frank E. Ross, Jr.

Association of St. Louis. He served as Diesel mechanical officer on the staff of the United States Railway Mission to Mexico from 1944 to July 1, 1945. He then joined Fairbanks, Morse & Co., as assistant to manager of the railroad division and in 1946 was appointed sales engineer in charge of Diesel locomotive sales.

Robert M. Close began his business career in 1933 as a commercial representa-



Robert M. Close

tive of the Southwestern Bell Telephone Company, St. Louis. In 1937 he joined the Aquart Manufacturing Company as a salesman. He became a partner of the firm in 1942 and acquired a controlling interest in 1945.

◆

SPICER MANUFACTURING DIVISION OF DANA CORPORATION. — *Robert B. Haynes*, formerly equipment manager of the Spicer Manufacturing division of the Dana Corporation in Toledo, Ohio, has been appointed to the newly-created position of works manager.

◆

EASTERN STATES PAINT & VARNISH CO. —*John F. Howe*, formerly with the paint division of the E. I. DuPont de Nemours Company, has joined the Eastern States Paint & Varnish Co. as vice-president, in charge of paint sales of metal protective

finishes for general industrial application covering the steel, railway, petroleum and marine industries.

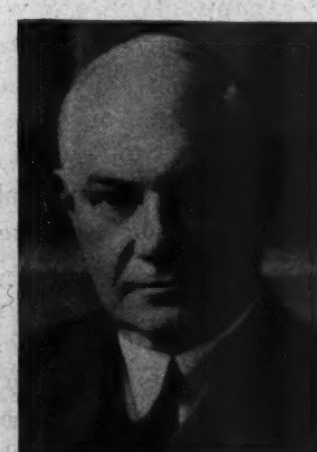
◆

BETHLEHEM STEEL COMPANY.—*Stewart J. Cort* has been appointed vice-president in charge of steel division operations of the Bethlehem Steel Company, to succeed *Quincy Bent* who has retired. Mr. Bent will continue as vice-president in an advisory and consulting capacity and as a director of the corporation until December 31.

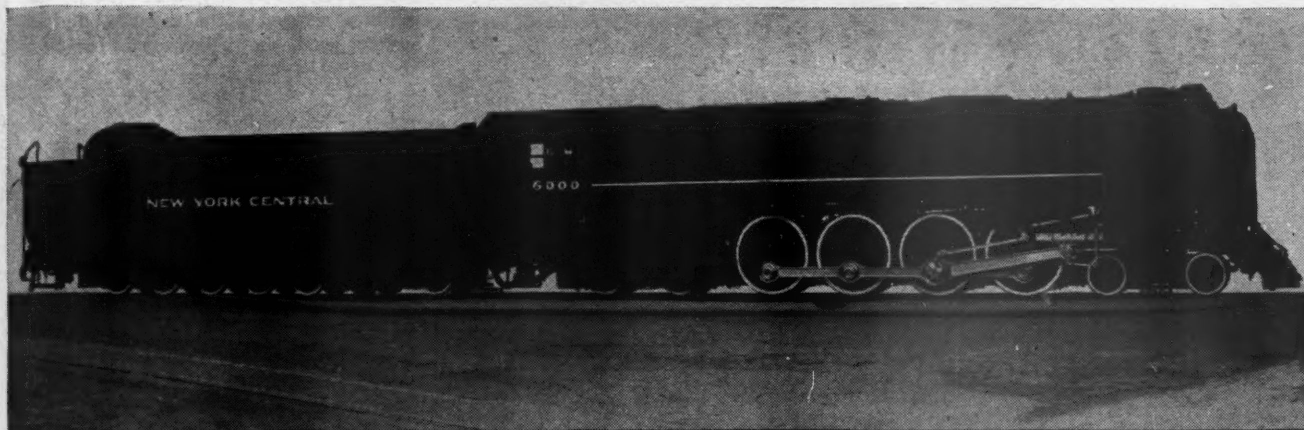
Stewart J. Cort began his business career at the Duquesne, Pa., plant of the Carnegie Steel Company, after graduating from Lehigh University in 1906. In 1916 he joined the Midvale Steel and Ordnance Company. In 1917 he was appointed superintendent of the Saucon Open Hearth division of the Bethlehem, Pa., plant of Bethlehem Steel and, in 1922, superintendent of the entire Saucon division. Mr. Cort was appointed general manager of the Sparrows Point, Md., plant in 1928, which position he held at the time of his recent appointment.

Stewart J. Cort

Quincy Bent was graduated by Williams College in 1901. Immediately after graduation he joined the Pennsylvania Steel Company. He was appointed assistant to the president of the Maryland Steel Company (a Pennsylvania Steel subsidiary) in 1909, and general manager of its Steelton, Pa., plant in 1916, the year in which Bethlehem



Quincy Bent



Steam Locomotives Roll Up RECORD MONTHLY MILEAGES on Timken Bearings

From October 1, 1946, through March 31, 1947, six 4-8-4 Niagara class, coal-fired steam locomotives of the New York Central System, operating between Harmon, N. Y., and Chicago (926 miles) made greater monthly mileages than were ever thought possible for steam engines.

The aggregate mileage of the six locomotives was 786,818 — an average of 22,000 miles per locomotive per month. Individual locomotives, however, made world records of 28,000 miles per month and higher.

This information was contained in a statement made recently by Mr. E. C. Payne, Chairman, steam locomotive performance subcommittee, Bituminous Coal Research, Inc., Pittsburgh, Pa.

It is particularly significant to railroad motive power officials in view of the fact that these six Niagara locomotives and twenty-one others of the same class are equipped with Timken Roller Bearings on all engine truck, driver and trailer truck axles and crank pins and have Timken light-weight reciprocating parts and Timken driving rods. Results, higher performance; lower maintenance; greater availability for service.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
RAILWAY ROLLER BEARINGS

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

NOT JUST A BALL ◯ NOT JUST A ROLLER ⊂⊃ THE TIMKEN TAPERED ROLLER ⊂⊃ BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

Steel acquired Pennsylvania Steel. Mr. Bent has served in the capacity of vice-president in charge of operations for Bethlehem since 1918.

◆

ELASTIC STOP NUT CORPORATION OF AMERICA.—The Elastic Stop Nut Corporation of America, Union, N. J., has purchased a majority stock interest in the *Buchanan Electrical Products Corporation*, Elizabeth, N. J.

◆

MAGNUS BRASS MFG. COMPANY.—*Allen-O'Neill Associates*, 221 Ninth street, San Francisco, Calif., has been appointed railroad representatives of the Magnus Brass Mfg. Company in the Pacific Coast area.

◆

HEWITT-ROBINS, INC.—The Hewitt rubber division of Hewitt-Robins, Inc., has announced the appointment of the *Industrial Supply Company* of Minneapolis, Minn., as a distributor of their industrial hose, belting and packing. The Robins conveyors division of the Hewitt-Robins has announced the appointment of the *St. Louis Railway Supply Company* as a distributor in the St. Louis, Mo., area.

◆

A. M. BYERS COMPANY.—*Paul S. Park* has been appointed manager of the engineering service department of the A. M. Byers Company, Pittsburgh, Pa. Mr. Park has been with the company nearly four years. During World War II he served as an officer in the Army Air Forces.

Paul S. Park

◆

ALLIS-CHALMERS MANUFACTURING COMPANY.—The Allis-Chalmers Manufacturing Company has announced the organization of a fifth region for the field organization of its general machinery division, to be designated as the Empire region and embracing the territory now covered by the New York, Buffalo, N. Y., Rochester, Syracuse and Newark, N. J., offices. The Rochester and Syracuse offices (formerly branch offices under the Buffalo district offices) and the Newark office (formerly a branch of the New York district office) automatically assume district office status under the regional plan. *Arch J. Cooper* will continue as New York district office manager in addition to regional manager; *Vernon L. Spinney*, formerly New York


MILE AFTER TROUBLEFREE MILE - - -
25
24,999
SCULLIN L-V TRUCKS
LATERAL VERTICAL
CUSHIONED MOTION
are making good
in gruelling daily service
On the Missouri Pacific and Southern Pacific—as on many other leading lines—they have been proving their trustworthiness for countless thousands of miles. There's no question about it—you're sure of economical high-speed safety for lading, cars and track when you specify Scullin L-V Trucks.
SOUTHERN LINES PACIFIC
MISSOURI PACIFIC LINES
M.P. 600214
STEEL CASTING MANUFACTURERS SINCE 1899
SCULLIN STEEL CO.
SAINT LOUIS 10, MISSOURI
NEW YORK • CHICAGO • CLEVELAND • BALTIMORE • RICHMOND, VA. • MEXICO CITY, D. F.

petroleum sales representative, has been appointed assistant district office manager; *William J. Devers,* formerly public utilities sales representative, New York district office, has been appointed Newark district office manager, and *N. W. Landis,* formerly branch manager of the Syracuse office has been appointed district manager.

Obituary

George A. Sutherland, sales representative of the Buckeye Steel Castings Company, at Chicago, died suddenly on October 16, at his home in Crystal Lake, Ill.

◆

Henry Billing, vice-president in charge of railway sales of the Collins Oil & Manufacturing Co. for the last nine years, died at his home in Elizabeth, N. J., on October 15. Mr. Billing was 56 years old. Before joining the Collins Company, he worked in the car department of the New York Central at Albany, N. Y., for 17 years.

◆

Frederick H. Thompson, a vice-president and member of the board of directors of the Simmons-Boardman Publishing Corporation since 1924 and an employee of this company and its predecessors since 1912, died at his home in Cleveland, Ohio, on November 14. He was 62 years old.

Mr. Thompson was born in Cleveland and educated at the Brooks School in that city and at the University School and Military Institute in East Orange, N. J. His business career began in 1904 when he joined the Music Trade Review as its eastern representative. Three years later he was appointed advertising manager for the American Engineer and Railroad Journal. From 1912 to 1920 he served as business manager of the Railway Mechanical Engineer. During the following four years he was general manager of the central district for Simmons-Boardman, serving in that capacity until his election as vice-president and a director.


Frederick H. Thompson

Ill health had forced Mr. Thompson's retirement from active participation in business some time ago, but he acted in an advisory capacity until his death.

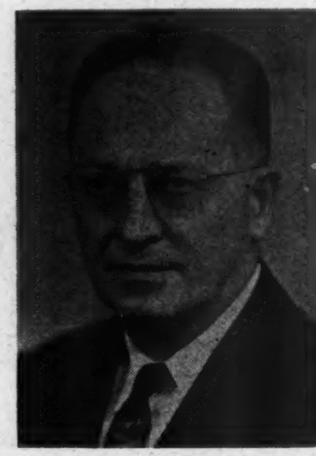
Personal Mention

General

J. E. Brown, superintendent of motive power of the St. Louis Southwestern at Pine Bluff, Ark., has retired.

A. D. Bingman, superintendent of equipment of the New York Central System, with jurisdiction over the territory Buffalo and east, and the Boston & Albany, at New York, has been appointed assistant to general superintendent of motive power and rolling stock of the New York Central System at New York.

J. H. Saltzgaber has been appointed superintendent of equipment of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Indianapolis, Ind. Mr. Saltzgaber's portrait appears here. That used with the sketch of his career on page 675 of the November issue was incorrect.



J. H. Saltzgaber

S. T. Kuhn, assistant superintendent of equipment of the Cleveland, Cincinnati, Chicago & St. Louis, at Indianapolis, Ind., has been appointed superintendent of equipment of the Indiana Harbor Belt and the Chicago River & Indiana and assistant superintendent of equipment of the New York Central lines west, with headquarters at Chicago.

James S. Thorp, assistant to president of the Delaware, Lackawanna & Western at New York, has retired. Mr. Thorp was born at Gainesville, Va., on February 1, 1885, and was graduated by Virginia Polytechnic Institute in 1910. He entered railroad service in 1902 as a machinist apprentice with the Southern at Spencer, N. C., and was a machinist when he entered college in 1906. In 1912 he became draftsman on the electrification of the New York, New Haven & Hartford between Stamford, Conn., and New Haven. From 1913 to 1917 Mr. Thorp served, successively, as assistant engineer on Norfolk & Western electrification; senior assistant engineer for British Insulated & Helsby Cables Co., on the Victorian railways electrification at Melbourne, Australia, and in the engineering department of Air Nitrates Company, Muscle Shoals, Ala. He became plant manager for an electrical porcelain manufacturer in 1919 and in 1923 he was appointed distribution engineer, Illinois Central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Here's a sure way to important savings: two P&H Welding Electrodes of such wide usefulness, they can do all your mild steel welding.
These are two P&H Electrodes *especially* suited for railroad welding — "PF" and "AP". They can mean an end to the stocking of dozens of types — and the ensuing high costs, waste and elaborate procedures. "PF" and "AP" are excellent for maintenance and repair work . . . for car and other fabrication. They provide faster, surer welding of both — for substantial savings in each.
Many progressive roads are using these two P&H Electrodes for as much as 90% of their mild steel welding. You, too, can have this unusual welding service. Why not talk to a P&H Railroad Sales Representative about "PF" and "AP"? Call or write today.
For that other 10% welding — there is a P&H Electrode — AC or DC — for welding all mild, alloy and stainless steels, and cast iron. Also types for building up and hard surfacing.
P&H Model WA-200 Arc Welder for shop work, Welding Service Range to 285 amperes. Other AC and DC models to meet all average requirements. Also skid and wheel mounted for all railroad needs.
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terminal improvements at Chicago, becoming assistant electrical engineer there in September, 1927. Mr. Thorp went with the Lackawanna in August, 1928, as electric traction engineer at Hoboken, N. J. He was appointed electrical engineer in August, 1930; assistant to vice-president, operations and maintenance on June 15, 1945, and assistant to president on April 1, 1946.

LAWRENCE RICHARDSON has been appointed assistant general manager (operations) of the New York, Susquehanna & Western at Paterson, N. J. Mr. Richardson was born at Shelbyville, Ky., on July 11, 1889. He attended the University of Illinois and received his M. E. degree in 1910 from Cornell University. He became a regular apprentice in the employ of the Pennsylvania at Altoona, Pa., in 1902; a special apprentice at Altoona in 1910; motive power inspector at Pittsburgh, Pa., in 1913 and foreman at Driftwood and Phillipston, Pa., in 1916. During 1917 and 1918 he was with the Thomas-Morse Aircraft Corp., Cornell University, Cornell Ground School, U. S. Army, and during 1918 and 1919, U. S. Naval Aviation, Massachusetts Institute of Technology, Cambridge, Mass., and Columbia University, New York. In 1919 Mr. Richardson went with the United States Railroad Administration, serving as assistant supervisor of equipment and supervisor of equipment. In 1921 he became sales engineer working on the Virginian railway for the American Steel Foundries Company. He was in charge of railroad sales for the Whiting Corp., in 1923-24, and then became contracting engineer for the Dwight P. Robinson Co. In 1926 Mr. Richardson went with the Boston & Maine

Lawrence Richardson

as assistant to chairman of the executive committee. He became assistant to president the following January; mechanical superintendent in April, 1927; chief mechanical officer in 1929, and in 1933 mechanical assistant to vice-president and general manager of the B. & M. and mechanical assistant to general manager of the Maine Central. He was appointed assistant general manager of the N. Y. S. & W. on September 1, 1947.

T. J. LYON, assistant to general superintendent motive power of the New York Central System at New York, has been appointed superintendent of equipment of

Unique RED LEAD "Soaps"
...check Rusting 3 Ways

Scientific research shows why Red Lead has long been regarded as the "standard" metal-protective paint.

One interesting factor is Red Lead's ability to react with the vehicle and produce unique lead "soaps."

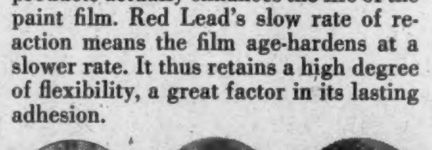
These "soap" formations grow to form a tough, impervious, intermeshing matrix within the paint film, as shown in the photomicrographs below. These "soaps" help Red Lead inhibit rust three ways.

1. Toughen Paint Film. Radiating from central cores the "soap" formations develop long, rod-like projections, which spread out and interlock. Thus, they form a dense intermeshing structure that *mechanically* reinforces and toughens the paint film.

2. Make Film Water-Resistant. The very structural formation of these "soaps," with their thick, impervious matrix of closely-knit fibres, helps restrict the passage of moisture through the paint film. And metal cannot rust without the presence of moisture.

3. Keep Film Flexible. The "soap" formations, far from being rigid, allow movement all along their soft, intertwining projections. The resulting flexibility helps prevent the ruptures to which a hard, unyielding paint film is subject. Thus the lead "soaps" aid in maintaining the continuity of the paint film.

Lead "soaps" form primarily in the dry paint film as it ages. This is where the "soap" formations impart their greatest benefits. When a paint film weathers and ages, decomposition products of the vehicle are formed. Red Lead's ability to slowly combine with these decomposition products actually enhances the life of the paint film. Red Lead's slow rate of reaction means the film age-hardens at a slower rate. It thus retains a high degree of flexibility, a great factor in its lasting adhesion.



The photomicrographs above show how Red Lead "soaps" progressively spread out as they grow and thus reinforce the paint film.

Remember, too, Red Lead is compatible with practically all vehicles commonly used in metal protective paints, including fast-drying resin types.

Specify RED LEAD for ALL Metal Protective Paints

The rust-resistant properties of Red Lead are so pronounced that it improves *any* metal protective paint. So, no matter what price you pay, you'll get a better paint if it contains Red Lead.

* * *

The benefit of our extensive experience with metal protective paints for both underwater and atmospheric use is available through our technical staff.

NATIONAL LEAD COMPANY: New York 6; Buffalo 3; Chicago 8; Cincinnati 3; Cleveland 13; St. Louis 1; San Francisco 10; Boston 6, (National Lead Co. of Mass.); Philadelphia 7, (John T. Lewis & Bros. Co.); Pittsburgh 30, (National Lead Co. of Pa.); Charleston 25, W. Va., (Evans Lead Division).

DUTCH BOY
Reg. U.S. Pat. Off.
RED LEAD

the New York Central with jurisdiction over the territory Buffalo and east, and the Boston & Albany, with headquarters at New York.

C. F. BURNS master mechanic of the New York Central at Springfield, Mass., has been appointed assistant superintendent of equipment at Cleveland, Ohio.

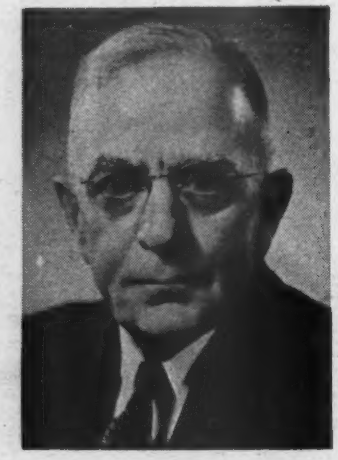
W. C. WARDWELL, master mechanic of the New York Central at Albany, N. Y., has been appointed assistant superintendent of equipment with headquarters at New York.

WALTER W. MATZKE has been appointed assistant to the vice-president—mechanical, of the Chicago & North Western, with headquarters at Chicago.

W. N. MESSIMER, superintendent of equipment of the New York Central at New York has been appointed superintendent of equipment of the subsidiary Merchants Despatch Transportation Corporation at Chicago.

O. M. HOUSER, master mechanic of the Cleveland, Cincinnati, Chicago & St. Louis at Indianapolis, Ind., has been appointed assistant superintendent of equipment at Indianapolis.

THOMAS F. POWERS, assistant to the vice-president-mechanical, of the Chicago & North Western, retired on November 1, after 47 years of service with the railroad. Mr. Powers was born on October 20, 1882, at Winona, Minn. He entered the employ of the North Western in 1899, as an apprentice and subsequently served as a mechanic, foreman, general forman-general boiler inspector, assistant superintendent of



T. F. Powers

motive power and machinery, superintendent of motive power, chief mechanical officer and assistant to vice-president—mechanical.

E. V. MYERS, superintendent of motive power, Texas division, of the St. Louis Southwestern, has been appointed superintendent of motive power of the system, with headquarters at Tyler, Tex., and an office at Pine Bluff, Ark., for supervision of the Northern division. A photograph and sketch of Mr. Myers' career appeared on page 160 of the March, 1947, *Railway Mechanical Engineer* at the time of his appointment as superintendent of motive power, Texas division.

I. W. MARTIN, superintendent of (locomotive) shop of the New York Central at West Albany, N. Y., has been appointed assistant to general superintendent of motive power, with headquarters at New York.

C. N. KITTLE, superintendent of shop of the New York Central at East Buffalo, N. Y., has been appointed assistant superintendent of equipment, with headquarters at New York.

Master Mechanics and Road Foremen

W. H. CHIDLEY, assistant master mechanic of the New York Central at East Syracuse, N. Y., has been appointed master mechanic, with headquarters at Springfield, Mass., and jurisdiction over the Boston & Albany.

F. J. FAHEY, assistant superintendent of equipment of the New York Central at New York, has been appointed master mechanic, with headquarters at Albany, N. Y.

F. P. NASH, master mechanic of the Illinois Central at Clinton, Ill., has retired after more than 40 years of service with the road.

H. L. HARRELL has been appointed master mechanic of the Illinois Central at Clinton, Ill.

Car Department

F. KOSSUTH, assistant general foreman of the Cleveland, Cincinnati, Chicago & St Louis, at Beech Grove, Ind., has been appointed superintendent of (car) shop of the New York Central, East Buffalo, N. Y.

JOHN A. WELSCH, who has been appointed superintendent of car department of the Illinois Central, with headquarters at Chicago, as noted in the November issue, was born on April 23, 1900, at Vicksburg, Miss. He began his railroad career with the Yazoo & Mississippi Valley (now I. C) in 1916 as a machinist apprentice in Vicksburg. He was subsequently machinist, district air-brake foreman and enginehouse foreman. In 1933 he was appointed general foreman and served successively at Baton Rouge, La., Vicksburg, and New Orleans, La. Mr. Welsch was appointed master mechanic at Paducah, Ky., in 1941, and shop superintendent in June, 1945.

Shop and Enginehouse

S. D. FOSTER, assistant superintendent of equipment of the New York Central at Chicago, has been appointed superintendent of shop at Collinwood, Ohio.

W. M. NAGLE, superintendent of shop of the New York Central at Collinwood, Ohio, has been appointed superintendent of (locomotive) shop, with headquarters at West Albany, N. Y.